QUALITY OF WATER

COLORADO RIVER BASIN

PROGRESS REPORT No. 5

JANUARY 1971

UNITED STATES
DEPARTMENT OF THE INTERIOR

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 12 1971

Dear Mr. Speaker:

Transmitted herewith is the biennial report (Progress Report No. 5 dated January 1971) on continuing studies of the quality of water of the Colorado River Basin. The report is transmitted pursuant to Section 15 of the Act of April 11, 1956 (70 Stat. 105), authorizing the Colorado River Storage Project and Participating Projects; Section 15 of the Act of June 13, 1962 (76 Stat. 96), authorizing the Navajo Indian Irrigation Project and the initial stage of the San Juan-Chama Reclamation Project; and Section 6 of the Act of August 16, 1962 (76 Stat. 102), authorizing the Fryingpan-Arkansas Project.

Sincerely yours,

Assistant Secretary of the Interior

Speaker of the House
of Representatives
Washington, D. C. 20515

IDENTICAL LETTER TO:

Hon. Spiro Agnew
President of the Senate
Washington, D. C. 20510

Enclosure

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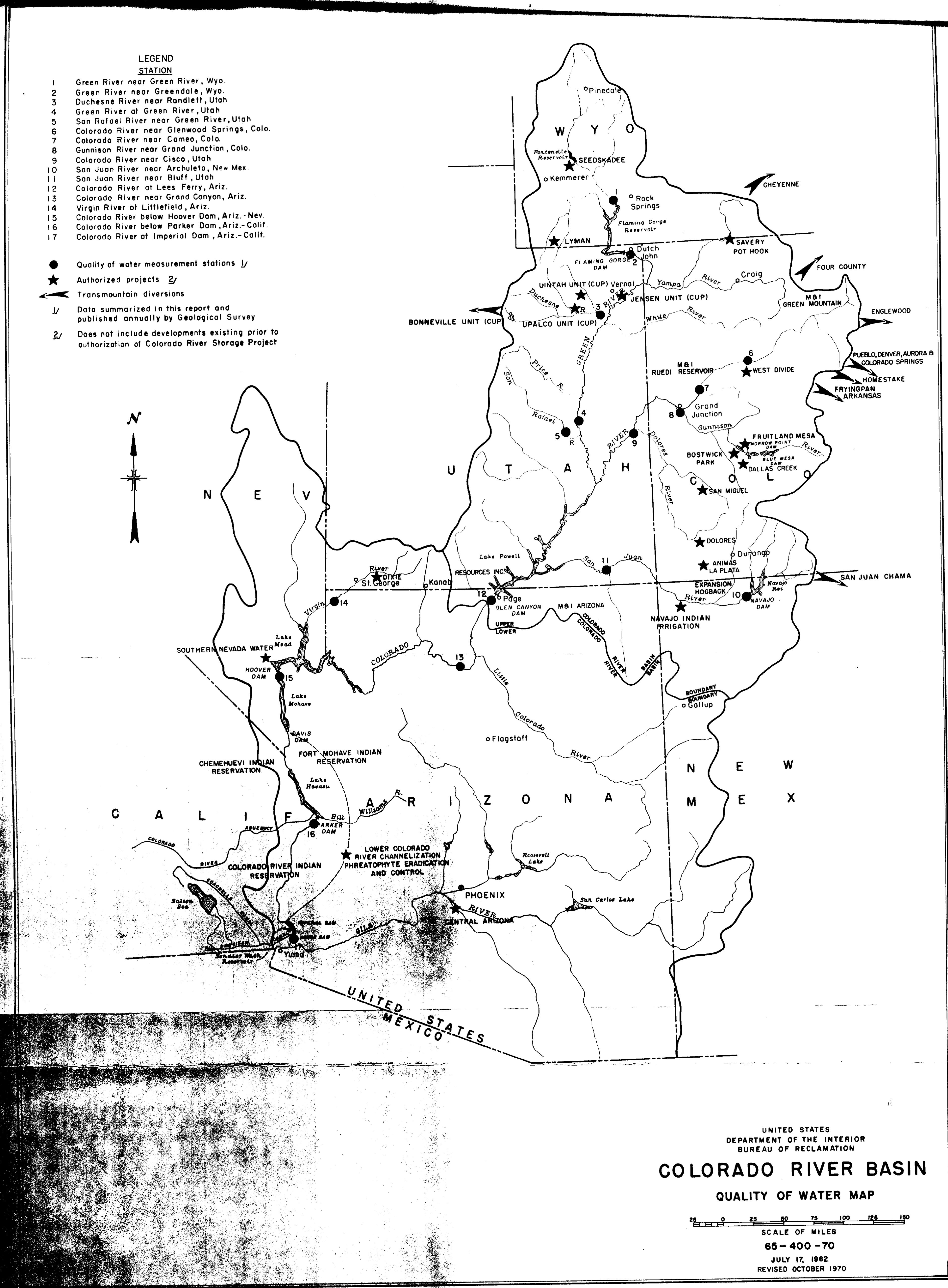
DEPARTMENT OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER BASIN

QUALITY OF WATER MAP

SCALE OF MILES (25 0 25 50 75 100 125 150)

65-400-70

JULY 17, 1962
REVISED OCTOBER 1970

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QUALITY OF WATER
COLORADO RIVER BASIN
PROGRESS REPORT

SUMMARY

This report presents the past, the present modified, and the future quality of water of the Colorado River down to Imperial Dam. The past is represented by a tabulation of the recorded or estimated historic condition at 17 quality of water stations for the 1941-68 period. The present modified condition includes adjustments of the historic condition based on the assumption that new developments completed during the 1941-68 period were in operation for the full period. The future quality condition is an estimate of the situation after the presently authorized developments and some projects proposed for authorization are placed in operation. These effects are primarily related to mineral quality although other quality factors are discussed in the report.

Studies of chemical trends indicate that under historic conditions the average concentration of dissolved solids of the Colorado River at Lees Ferry had about 0.75 ton per acre-foot, below Hoover Dam about 0.94 ton per acre-foot, and at Imperial Dam about 1.02 tons per acre-foot for the 1941-68 period.

Under present modified conditions (that is assuming that the recently constructed projects were in operation for the entire period) the concentrations would have been about 0.84, 1.03, and 1.18 tons per acre-foot, respectively, at the three stations.

It has been assumed for purposes of this study that the rate of pickup of dissolved solids from new irrigated lands would vary from zero to 2 tons per acre. It was also assumed no additional pickup of dissolved solids would occur for lands already under irrigation.

Under future conditions, assuming negligible salinity control measures, with all authorized projects and projects proposed for authorization in operation and with an assumed pickup of 2 tons per acre on the new irrigated lands, the concentrations are estimated to be 1.09 tons per acre-foot at Lees Ferry, 1.38 tons per acre-foot below Hoover Dam, and 1.70 tons per acre-foot at Imperial Dam.

The depletions used in this report for the projects, both authorized and proposed for authorization together with present developments and other proposals, are estimated to be the ultimate depletions for the developments listed. Other developments, as yet not identifiable, are expected to occur which will reduce the quantities of water shown for the various stations and cause some changes in concentrations from those indicated in this report.

SUMMARY

This report also includes discussions of the effects of salinity on water uses and potentials for salinity control measures within the basin.

Other water quality aspects including sources of pollution and parameters other than salinity are discussed. These parameters include sediment, dissolved oxygen, temperature, pH, heavy metals, toxic materials, nutrients, bacteria, and radioactivity.

PART I. INTRODUCTION

A. Legislative Requirements for Report

This is the fifth progress report on Quality of Water in the Colorado River Basin. The directive for preparing this and the four previous reports is contained in three separate public laws. Section 15 of the authorizing legislation for the Colorado River Storage Project and participating projects, Public Law 485, 84th Congress, Second Session, April 11, 1956, states, "The Secretary of the Interior is directed to continue studies and make a report to the Congress and to the States of the Colorado River Basin on the quality of water of the Colorado River."

A progress report to comply with Public Law 84-485 was in preparation when the authorizing legislation for the San Juan-Chama Project and the Navajo Indian Irrigation Project (P.L. 87-483) became effective on June 13, 1962. Section 15 of this act states, "The Secretary of the Interior is directed to continue his studies of the quality of water of the Colorado River system, to appraise its suitability for municipal, domestic, and industrial use and for irrigation in the various areas in the United States in which it is used or proposed to be used, to estimate the effect of additional developments involving its storage and use (whether heretofore authorized or contemplated for authorization) on the remaining water available for use in the United States, to study all possible means of improving the quality of such water and of alleviating the ill effects of water of poor quality, and to report the results of his studies and estimates to the Eighty-Seventh Congress and every two years thereafter."

A few weeks later Public Law 590, 87th Congress, Second Session, which authorized the Fryingpan-Arkansas Project, was passed with a similar section pertaining to quality of water reports. This public law, however, stipulated that January 3, 1963, would be the submission date for the initial report and that the reports should be submitted every 2 years thereafter.

B. Previous Reports

The January 1963 report prepared by the Department of the Interior was comprised of two parts: (1) an assessment of the water quality situation in the part of the Colorado River Basin above Lee Ferry, Arizona, as of 1957, prepared by the Geological Survey; and (2) a projection of the water quality effects to be expected from additional developments that involve storage and irrigation use of river waters above Lee Ferry by the Bureau of Reclamation.

INTRODUCTION

The January 1965 report appraised the water quality conditions in the Colorado River Basin above Imperial Dam using the period 1941-61 as a base and included data from two points not considered in the 1963 report. The 1967 report included 3 additional years of record and included suspended sediment data for six stations.

Changes made in the January 1969 Progress Report included (1) consideration of the Hammond Project under present modified conditions, (2) an average of about 9,000 acre-feet of water now being used by Cheyenne, Wyoming, (3) the addition of another key station, Colorado River near Glenwood Springs, (4) the net future effects of Upper Colorado River Storage Unit operations being limited to evaporation only, (5) elimination of the Marble Canyon Project, (6) addition of the Central Arizona Project by pumping, (7) addition of the Fort Mohave and Chemehuevi Indian lands, and (8) addition of the Colorado River Indian Project. Other additions included 2 more years of record through 1966, discussions of state water quality standards, industrial wastes, municipal problems, temperature data, and salinity control.

Following, in addition to including 2 more years of record, are changes which have occurred since completion of the January 1969 report and which are incorporated in this report: (1) showing present modified flows and corresponding dissolved solids only on a mean annual basis (1941-68) rather than on a year-by-year, month-by-month basis; (2) eliminating the Green River near Ouray, Utah, station; (3) considering Silt and Emery County Projects as existing rather than future projects; (4) including estimated average reservoir evaporation losses not reflected in historic records as a part of present modified flows; (5) showing only "Historical, Present Modified, and Future" conditions on the Summary Table No. 18 ; and (6) addition of discussions of agricultural wastes, mine drainage, dissolved oxygen, pH, toxic materials including pesticides, heavy metals, nutrients, and radioactivity.

In order to keep each report self-contained, it has been necessary to include some of the text material and tables from these previous reports in this fifth progress report dated January 1971.

C. Cooperation

This report was prepared by the Bureau of Reclamation with assistance of the Geological Survey and Federal Water Quality Administration. The Geological Survey provided most of the basic data and prepared some of the sections of "Basic Studies." A continuing cooperative program between the Bureau of Reclamation and the Survey for the collection of streamflow quality data and the exchange of information has been in effect for a number of years. This cooperation provides for the collection of data at stations other than those normally maintained by the Survey. The Federal Water Quality Administration who collects samples where needed in areas not covered by the Geological Survey or Bureau of Reclamation has also participated extensively in preparing this report. Data collected by the Metropolitan Water District of Southern California have also been included in this report.

Below Hoover Dam, water quality along the main stem of the river is determined by analyzing daily samples taken at key stations. Data obtained above each project diversion and below the return flow from each project show the effect of irrigation on water quality in each section of the river. Data are obtained periodically at various points along the river and in drains in cooperation with the Geological Survey, the Colorado River Indian Agency, the Metropolitan Water District of Southern California, the Imperial Irrigation District, and others.

D. Scope

This report presents data concerning (1) the historical quantity and quality of the flows of the Colorado River and its principal tributaries for the 1941-68 period; (2) an evaluation of historical conditions modified to reflect present development; and (3) a projection of the range of salinity conditions resulting from future development at 17 selected stations in the basin. The potential for salinity control and the current status of salinity control activities are also discussed. A section of the report is devoted to water quality parameters other than salinity.

E. Water Quality Legislation

In addition to the legislative requirements previously discussed for studies of water quality in the Colorado River Basin, other legislation authorizes the Secretary of the Interior to conduct various activities directed toward the protection and enhancement of water quality.

The Federal Water Pollution Act, P.L. 84-660, as amended (P.L. 87-88, P.L. 89-234, P.L. 89-753, and P.L. 90-224), established a national policy of water quality enhancement through the prevention, control, and abatement of water pollution. The Secretary is directed by the act to cooperate with other Federal and State agencies as well as involve municipalities and industries in the development of comprehensive programs aimed at reducing the water quality degradation in interstate streams and associated tributaries.

The Water Quality Act of 1965 amended the Federal Water Pollution Control Act to require the establishment of water quality standards for all interstate waters. These standards were to consist of water quality criteria and a plan for implementation and enforcement of the criteria. Establishment of such standards was thus required for the Colorado River and its interstate tributaries.

INTRODUCTION

Each of the seven Basin States proceeded with actions directed toward establishment of standards for the Colorado River. Early in the standards-setting process, it became apparent to the states that, because of legal and institutional constraints combined with lack of technical knowledge on salinity control and management, it would be very difficult to establish numerical salinity standards which would be workable, equitable, and enforceable.

The seven Basin States subsequently developed water quality standards which did not include salinity standards and submitted these standards to the Secretary for review and approval. Following a period of review and negotiations with the states in an attempt to establish suitable numerical salinity standards, former Secretary of the Interior Stewart Udall reached a decision on approval of the proposed standards. In recognition of the problems associated with establishing numerical standards, the Secretary approved the proposed standards with the understanding that suitable numerical criteria would be established by the states at some future date when sufficient information on which to base such criteria had been developed. The states have taken no further formal action to establish numerical salinity standards. A number of the investigations reported herein have been undertaken to improve the technical knowledge of salinity control and provide part of the basis on which suitable standards could be established.

Beginning in 1960 six of the seven states of the basin have met in eight conferences to discuss water quality problems. Three of these conferences have been of a technical nature dealing with specific pollution sources and problems. Initially, the conferences were primarily concerned with pollution from radioactive sources, but from 1963 to the present the emphasis has been directed more toward salinity problems of the basin. Five of the conferences have considered this water quality problem.

In the second technical conference in February 1964 the state conferees assigned the Colorado River Basin Water Quality Control Project of the U.S. Public Health Service in Denver, Colorado, the following general objectives:

(1) Assess the nature and magnitude of the salinity problem in the Colorado River system,

(2) Evaluate feasible methods of control and salt-load reduction in the river, and

(3) Determine net basinwide economic benefits associated with various levels of salinity control.

The Federal Water Quality Administration has concluded the studies begun by the Public Health Service to meet these objectives.

PART II. DESCRIPTION OF BASIN

A. Geology

The upper or northern portion of the Colorado River Basin in Wyoming and Colorado is a mountainous plateau 5,000 to 8,000 feet in elevation marked by broad, rolling valleys, deep canyons, and intersecting mountain ranges. Hundreds of peaks in these mountain chains rise to more than 13,000 feet above sea level and many exceed 14,000 feet in elevation. Mountain lakes exist in considerable numbers. The southern portion of the Upper Basin is studded with rugged mountain peaks interspersed with broad, alluvial valleys and rolling plateaus. The main stream and its tributaries in Colorado generally flow in deep mountain canyons. The Green River, primary tributary of the Colorado River, flows in similar canyons in Wyoming, Colorado, and Utah after rising in the Wind River Mountains. The San Juan River, a large tributary, emerges from the mountains of southwestern Colorado, flows through northwestern New Mexico, and then traverses the deep canyons of the San Juan in Utah before joining the Colorado River in Glen Canyon. The Glen Canyon section of the main stream and tributaries lies almost entirely in deep canyons.

Rocks of all ages from those of the Archean age (the oldest known geological period) to the recent alluvial deposits, including igneous, sedimentary, and metamorphic types, are found in the Colorado River Basin. The high Rocky Mountains which dominate the topography of the upper regions are composed of granites, schists, gneisses, lava, and sharply folded sedimentary rocks of limestone, sandstone, and shale. Many periods of deposition, erosion, and upheaval have played a part in the present structure of these mountains.

In contrast to the folded rocks of the mountains which fringe the basin, the plateau country of southwestern Wyoming, eastern Utah, and northern Arizona is composed principally of horizontal strata of sedimentary rocks. Slow but constant elevation of the land area has allowed the Colorado River and its tributaries to cut narrow, deep canyons into the flat-topped mesas. This type of erosion reaches its culmination in the Grand Canyon where the Colorado River has cut through all of the sedimentary rocks down to the oldest Archean granites.

The Lower Basin is characterized by broad, flat valleys separated by low ranges. These valleys are filled by large accumulations of alluvial deposits.

Sediment removed by constant erosion of the upper areas was deposited in Arizona, California, and Mexico and now forms the great delta of the Colorado River.

DESCRIPTION OF BASIN

Reservoirs constructed above Lee Ferry (Lake Powell, Flaming Gorge, Fontenelle, Navajo, Morrow Point, and Blue Mesa), together with Lake Mead downstream, have caused some major changes in stream regimen: (1) The stream channels inundated by these reservoirs will no longer be subjected to natural stream erosion, (2) the accumulation of sediment and water within the reservoirs slows the growth and flooding of the Colorado River delta, (3) flooding has diminished in many areas, and (4) sections of sediment-laden streams have given way to clear water streams and lakes.

The mineral concentration in runoff increases from the headwater areas downstream and occurs in relation to the geologic character of the terrain across which the Colorado River and its tributaries flow. The geologic formations that largely contribute to the mineral concentrations in natural runoff are evaporites of Paleozoic age, shale of Cretaceous age, and salt and gypsum of Tertiary age.

B. Soils

The soils of the Colorado River Basin closely resemble the geologic formations of their origin. Only in limited areas at the higher elevations has the precipitation leached the soil mass of its soluble constituents. Over most of the area both residual and transported soils are basic in reaction and well supplied with carbonates with normal or mature soils exhibiting a distinct horizon of carbonate accumulation. The impress of soil-forming factors has resulted in the widespread development of soils classified as members of the Gray-Desert Great Soil Group. In areas with higher rainfall, soils of the Brown and Chestnut Great Soil Groups have developed. Saline and alkali (sodic) soils occur in many parts of the basin.

The residual soils comprise the larger area and are usually shallow in depth over shale and sandstone of various ages. Many of the shales are saline but contain much gypsum as well as other chloride and sulphate salts. Some formations are high in sodium chloride and some have sodium carbonate or bicarbonate strata. Very few residual soil areas are suitable for irrigation development.

The alluvial materials are extremely variable and range from alluvial fans and terraces, outwash plains, to lacustrine sediments. Some areas have soils from material transported only short distances and resemble the original materials. Other areas have soils which have been transported and mixed extremely well. Most of the agricultural areas are on these well-mixed alluviums and, therefore, the soils are quite variable.

Extensive areas of Eolian deposits occur in parts of the basin, principally in southwestern Colorado. The uniformly textured soils are reddish brown in color and have no resemblance to either the underlying formations or adjacent areas. These are excellent agricultural soils, but in many areas topography makes agriculture difficult.

C. Climate

The Colorado River Basin has climatic extremes, ranging between year-round snow cover and heavy precipitation on the high peaks of the Rocky Mountains to desert conditions with very little rain in the southern part of the basin. This wide range of climate is caused by differences in altitude, latitude, and by the configuration of the high mountain ranges. The encircling mountain ranges obstruct and deflect the air masses to such an extent that storm patterns are more erratic than in most other parts of the United States. Most of the moisture for precipitation on the Upper Basin is derived from the Pacific Ocean and the Gulf of Mexico. The Pacific source predominates generally from October through April and the Gulf source during the late spring and early summer.

In the northern part of the basin most precipitation falls in the form of winter snows and spring rains. Summer storms are infrequent but are sometimes of cloudburst intensity in localized areas. In the more arid southern portion the principal rainy season is in the winter months with occasional localized cloudbursts in the summer and fall.

Extremes of temperature in the basin range from 50° F. below zero to 130° F. above zero. The northern portion of the basin is characterized by short, warm summers and long, cold winters, and many mountain areas are blanketed by deep snow all winter. The southern portion of the basin has long, hot summers, practically continuous sunshine, and almost complete absence of freezing temperatures.

Nevertheless, the entire basin is arid except in the extremely high altitudes of the headwaters areas. Rainfall averages as low as 2.5 inches in the southern end of the basin while total precipitation in the high mountains may range from 40 to 60 inches annually.

D. Vegetation

Areas of higher elevation are covered with forests of pine, fir, spruce, and silver-stemmed aspens, broken by small glades and mountain meadows. Pinon and juniper trees, interspersed with scrub oak, mountain mahogany, rabbit brush, bunch grasses, and similar plants grow in the intermediate elevations of the mesa and plateau regions. Large areas in the Upper Basin are dominated by big sagebrush and related vegetation. Many of the streams are bordered by cottonwoods, willows, and salt cedar.

Scattered cottonwoods and chokecherries grow in the canyons with the cliff rose, the redbud, and blue columbine. A profusion of wildflowers carpets many mountain parks. At lower elevations large areas are almost completely devoid of plant life while other sections are sprinkled with desert shrubs, Joshua trees, other Yucca plants, and saguaro cacti, some of the latter giant plants reaching 40 feet in height. Occasionally, cottonwoods or desert willows are found along desert streams with mesquite and creosote bush or catclaw and paloverde. In recent years many river channels have been overrun with tamarisk or salt cedar to the extent that a large volume of water is being consumed by such vegetation. Measures are being taken to curb the growth of phreatophytes to conserve water.

E. Hydrology

The Colorado River begins where peaks rise more than 14,000 feet high in the northwest portion of Colorado's Rocky Mountain National Park, 70 miles northwest of Denver. It meanders southwest for 640 miles through the Upper Basin to Lee Ferry. The Green River, its major tributary, rises in western Wyoming and discharges into the Colorado River in southeastern Utah--730 river miles south of its origin and 220 miles above Lee Ferry. The Green River drains 70 percent more area than the Colorado River above their junction but produces only about three-fourths as much water. The Gunnison and the San Juan are the other principal tributaries of the Upper Colorado River.

The flows of the San Juan River are now controlled by the Navajo Dam, the Green River by Fontenelle and Flaming Gorge Dams, and the Gunnison River by the Curecanti Unit Dams. Glen Canyon Dam is the only major dam on the main stem of the Colorado above Lee Ferry, but it will permit control of almost all flows leaving the Upper Basin.

The flow at various points in streams in the Colorado River Basin for the 1941-68 period is given in Tables 1 through 17. The records of flow depict the characteristic wide fluctuations from month-to-month and the considerable variation from year-to-year. The recently constructed storage reservoirs will now level out some of these fluctuations.

The natural drainage area of the lower Colorado River below Lee Ferry and above Imperial Dam is about 75,100 square miles. This section of the river is now largely controlled by a series of storage and diversion dams starting with Hoover Dam and ending at Imperial Dam.

At the present time there is no significant storage on the main river or on the tributaries between Glen Canyon Dam and Lake Mead. The intervening tributary inflow is erratic but amounts to almost enough to offset the evaporation from Lake Mead.

DESCRIPTION OF BASIN

Lake Mead provides most of the storage and regulation in the Lower Colorado River Basin with the water being stored for irrigation and municipal and industrial uses, generation of electrical power, and other beneficial uses.

Lake Mohave, the reservoir formed by Davis Dam, backs water at high stages about 67 miles upstream to the tailrace of Hoover Powerplant. Storage in Lake Mohave is used for some reregulation of releases from Hoover Dam, for meeting treaty requirements with Mexico, and for developing power head for the production of electrical energy at Davis Powerplant.

The river flows through a natural channel for about 10 miles below Davis Dam at which point the river enters the broad Mohave Valley 33 miles above the upper end of Lake Havasu.

Lake Havasu backs up behind Parker Dam for about 45 miles and covers about 25,000 acres. Lake Havasu serves as a forebay from which the Metropolitan Water District of Southern California pumps water into the Colorado River Aqueduct. Lake Havasu also controls floods originating below Davis Dam.

Headgate Rock Dam, Palo Verde Diversion Dam, and Imperial Dam all serve as diversion structures with practically no storage. Imperial Dam, located some 150 miles downstream from Parker Dam, is the major diversion structure to irrigation projects in the Imperial Valley and Yuma areas. It diverts water on the right bank to the All American Canal which delivers water to the Yuma project in Arizona and California and Imperial and Coachella Valleys in California. It diverts on the left bank to the Gila Gravity Main Canal.

The Senator Wash Dam also affords regulation in the vicinity of Imperial Dam and assists in the delivery of water to Mexico.

PART III. HISTORY OF WATER RESOURCE DEVELOPMENT

A. Irrigation Development

Irrigation development in the Upper Basin took place gradually from the beginning of settlement about 1860 but was hastened by the purchase of land from the Indians in 1873. About 800,000 acres were irrigated by 1905. Between 1905 and 1920 the development of irrigated land continued at a rapid pace, and by 1920 nearly 1,400,000 acres were irrigated. The development then leveled off and increase since that time has been slow. In 1965, 1,600,000 acres were under irrigation in the Upper Basin.

The slow growth in irrigated acreage in the Upper Basin in the last 45 years is ascribed to both physical and economic limitations on the availability of water. By 1920 most of the lower cost and more easily constructed developments were in operation, and, although some new developments have taken place since that time, they have been partially offset by other acreages going out of production.

Irrigation development began in the Lower Basin about the same time as in the Upper Basin. Development was slow because of difficult diversions from the Colorado River with its widely fluctuating flows. Development of the Gila area began in 1875 and the Palo Verde area in 1879. The development rate increased in the period 1900-10 with construction of the Yuma Project, the Palo Verde Canal and intake, and other irrigation projects along the river. Construction of Boulder Canyon Project in the 1930's and other downstream projects since that time has continued to expand the irrigated areas until about 25,500 acres in Utah, 12,000 acres in Nevada, and 789,500 acres below Hoover Dam are irrigated under organized irrigation systems. An additional unknown acreage is irrigated by private pumping from wells in the river aquifers in the Lower Colorado River Basin.

B. Streamflow Depletions

Development and utilization of the basin's water resources results in depletions of streamflows. Consumptive use of water by irrigated crops and exports to other basins produce the greatest flow depletions. Reservoir evaporation and consumptive use of water for municipal and industrial purposes also produce significant depletions.

For the 1941-68 period of record consumptive use of water by irrigated crops in the Upper Basin was estimated to average 1,727,000 acre-feet annually. This is low in comparison to the irrigated acreage, but some lands do not receive a full supply.

Water exported from the Upper Basin during the same period averaged about 357,000 acre-feet per year. Since completion of the Colorado-Big Thompson Project with initial diversions made in year 1947, the Duchesne Tunnel completed in 1953, and the Roberts Tunnel completed in 1963, the transmountain diversions have increased to around 500,000 acre-feet.

Consumptive use of water for municipal and industrial purposes in the Upper Basin produced a minor depletion of about 30,000 acre-feet annually.

Reservoir evaporation varies from year to year but the variations have little effect on average streamflow depletions. For the period of record considered, average reservoir evaporation in the Upper Basin was minor as the large reservoirs of the Colorado River Storage Project did not begin filling until late in the period. Under normal operating conditions, evaporation from the Colorado River Storage Project reservoirs is expected to average about 600,000 acre-feet annually.

For the 1941-68 period of record, streamflow depletions in the Upper Basin totaled about 2 million acre-feet.

In the Lower Basin above Imperial Dam water is exported to the Southern California coastal areas and to Imperial and Coachella Valleys and delivered to irrigated areas along the river in Arizona and California, principally to the Colorado River Indian Reservation, Palo Verde Irrigation District, Gila Project, and Yuma Project. Water is also delivered to Mexico at the International Boundary as well as consumed by phreatophytes or evaporated.

C. Legal Aspects

1. Colorado River Compact

Water of the Colorado River was divided between the Upper and Lower Colorado River Basins by the Colorado River Compact which was signed in 1922 by a commissioner of each of the seven States of the river basin and by a representative of the United States. All States but Arizona ratified the compact prior to its effective date in 1929. The dividing point on the river between the Upper and Lower Basins is at Lee Ferry which is defined as a point 1 mile below the mouth of the Paria River. The compact apportions from the Colorado River system to each of the Upper and Lower Basins in perpetuity for exclusive beneficial consumptive use a total of 7,500,000 acre-feet annually. In addition to the apportionment of 7,500,000 acre-feet, the Lower Basin is given the right to increase its beneficial consumptive use of water from the Colorado River system by 1 million acre-feet annually. The compact further provides that the States of the upper division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 million acre-feet for any period of 10 consecutive years.

One provision in the compact permits exportation of the water out of the basin as long as it is used beneficially in the seven Basin States, and another provision recognizes the obligations of the United States to the Indian Tribes. The compact prescribes the manner in which the waters of the Colorado River system may be made available to Mexico under any water rights recognized by the United States.

The compact, in effect, cleared the way for legislation authorizing the construction of major projects such as Boulder Canyon Project, and it also cleared the way for compacts or agreements within the Upper and Lower Basins to further divide the water among the States.

2. Mexican Treaty

The treaty with Mexico, signed in 1944, provides basically for a guarateeed annual delivery by the United States to Mexico of 1,500,000 acre-feet of Colorado River water.

3. Upper Colorado River Basin Compact

With the water allocated to the Upper Basin by the Colorado River Compact and with the Mexican Treaty signed, the Upper Basin States began negotiations which resulted in the signing of the Upper Colorado River Basin Compact in 1948. Under the terms of the compact, Arizona is permitted to use 50,000 acre-feet of water annually from the Upper Colorado River system, and the remaining water is apportioned to the other Upper Basin States in the following percentages.

State of Colorado	51.75 percent
State of New Mexico	11.25 percent
State of Utah	23.00 percent
State of Wyoming	14.00 percent

Congress had previously been unwilling to approve projects without assurance that a water supply would be available, so this division of water among the States permitted development in the Upper Basin to proceed and resulted primarily in the authorization of most of the Federal projects above Lee Ferry that are mentioned in this report.

Neither of the compacts specifically mentions water quality, but it has been recognized as a factor to be considered in developing projects, and water quality studies have been required by recent legislation authorizing the construction of projects in the Upper Basin.

4. Arizona vs. California Suit in the Supreme Court

The States of the Lower Basin have never agreed to a compact for the division of use of the waters of the Lower Colorado River Basin. The

HISTORY OF WATER RESOURCE DEVELOPMENT

State of Arizona filed suit in the Supreme Court of the United States in October 1952 against the State of California and others for the determination of the rights to use the waters of the Lower Colorado River system. The Supreme Court gave its decision on June 3, 1963, and issued a decree on March 9, 1964, providing for the apportionment of the use of the waters of the main stream of the Colorado River below Lee Ferry among the States of Arizona, California, and Nevada. The States of Arizona and New Mexico were granted the exclusive use of the waters of the Gila River system in the United States. The decree did not affect the rights or priorities to the use of water in any of the other Lower Basin tributaries of the Colorado River.

The decree permitted the States of the Lower Basin to proceed with developments to use their apportionments of Colorado River water. Major new developments include the Southern Nevada Water Project in Nevada, the Dixie Project in Utah, and the Central Arizona Project in Arizona. Development of the Indian lands is expected to use all of the water allocated to them by the decree. These lands include the Colorado River Indian Reservation, Arizona-California; the Fort Mohave Indian Reservation, Arizona-California-Nevada; and the Chemehuevi Indian Reservation, California.

5. Colorado River Basin Project Act (Public Law 90-537, 90th Congress, September 30, 1968)

The major items provided in the law include the following:

Construction of the Central Arizona Project consisting of a system of main conduits and canals including a main canal and pumping plants (Granite Reef aqueduct and pumping plants) for diverting and carrying water from Lake Havasu to Orme Dam or suitable alternative.

Construction of five multiple-purpose projects in Colorado; the Animas-La Plata, Dolores, Dallas Creek, West Divide, and San Miguel; and one in Utah, the Uintah Unit of the Central Utah Project, upon completion and approval of a feasibility report to Congress.

Establishment of a Lower Colorado River Development Fund.

Development of criteria for the coordinated long-range operation of the Federal reservoirs, equalizing the storage in Lake Mead and Lake Powell.

Directed that the Secretary of the Interior shall conduct full and complete reconnaissance investigations for the purpose of developing a general plan to meet the future water needs of the Western United States, except that for a period of 10 years from the date of the act, studies shall not be undertaken of any plan for the importation of water into the Colorado River Basin from any other natural river drainage basin lying outside the States of Arizona, California, Colorado, New Mexico, and those portions of Nevada, Utah, and Wyoming which are in the natural drainage basin of the Colorado River.

Directed the Secretary to make reports of annual consumptive use and losses of water from the Colorado River system.

D. Economic Conditions

The prosperity of agriculture in the Upper Colorado River drainage basin generally parallels the prosperity of the livestock industry. With vast areas of fine rangeland available for summer grazing, livestock production is limited by the production of hay for winter feed.

Intensified development of mineral resources in recent years has created new employment opportunities, including off-the-farm work for many farmers. The most extensive and commercially important mineral resources of the Upper Basin are coal, oil, and natural gas. The Upper Basin is also the leading domestic source of vanadium, uranium, radium ore, and molybdenum. Copper, zinc, lead, silver, and gold are also commercially important. In recent years mining of trona has become extensive in the State of Wyoming. The increase in population resulting from new job opportunities has created new markets for locally produced and imported products, has taxed municipal facilities and water supplies in several areas, and has increased demands for electricity. Raw materials are stimulating industrial activities in areas adjoining the upper drainage basin, particularly areas near Denver, Pueblo, Provo, and Salt Lake City. These adjoining areas all import water from the Colorado River Basin and without the imported water their economic growth would be limited.

Tourism as an industry has increased significantly in recent years because of the many natural attractions. Manufacturing as a basic industry is of relatively minor importance in the Upper Basin.

Irrigated areas in the Lower Colorado River Basin and in adjoining basins using Colorado River main stream water are highly productive and the agricultural operations very intensified. Gross crop values per acre probably are greater than any other area of comparable size in the world with a 1968 average gross crop income of $415 per acre.

The Pacific Southwest is one of the most rapidly developing areas in the Nation, both industrially and populationwise. Colorado River water for municipal and industrial purposes is supplied to approximately 130 incorporated towns and other communities in this area with a population of about 10 million people. This water supply, which totaled about 1,200,000 acre-feet in 1968, ranges from a minor supplemental supply for some entities to a complete supply for others.

PART IV. BASIC STUDIES

A. Study Objectives

The Secretary of the Interior is required by various legislative acts to report on the quality of water in the Colorado River Basin, to evaluate the suitability of the water for beneficial uses, to estimate the effects of future development on water quality, and to investigate means of improving water quality. A number of basic studies have been undertaken by the Bureau of Reclamation, the Geological Survey, and the Federal Water Quality Administration in compliance with these legislative requirements.

These studies include the collection of data for evaluating quality of water investigations, studying the effects existing water resource developments have had on water quality, detecting and defining water quality trends and predicting the effects of future development on water quality, defining the suitability of Colorado River water for beneficial use, and evaluating water quality control measures. These studies are discussed in the following Parts IV to IX of this report.

B. Effects of Impoundments

1. Flaming Gorge Reservoir

Quality of water in the reservoir.--In October 1966 and September 1968 water quality samples were collected at the surface, bottom, and seven intermediate points from each of six sites in the reservoir. Some additional data are also available from three sites for September 1967. The approximate dissolved-solids distribution in the reservoir during sampling times is shown in Figures 2 and 3 . Available data are insufficient to define the annual limnological cycle of Flaming Gorge Reservoir. Figures 2 and 3 represent chemical-quality conditions in the reservoir in the fall of 1966, 1967, and 1968. The less concentrated spring and summer runoff can be seen at the lower end of the reservoir. These exiguous data for the period 1966-68 indicate that the water probably takes an average of about 3 months to move the length of the reservoir.

The measured load of dissolved solids in the reservoir on October 1, 1966, was about 1,850,000 tons. This figure was computed using the chemical-quality data from the six sampling verticals and area capacity curves. In order to determine initial leaching and storage, a theoretical load as of October 1, 1966, was also computed, using available inflow and outflow data. The theoretical load was 1,050,000 tons, and this represents the net amount of dissolved solids contributed to the reservoir

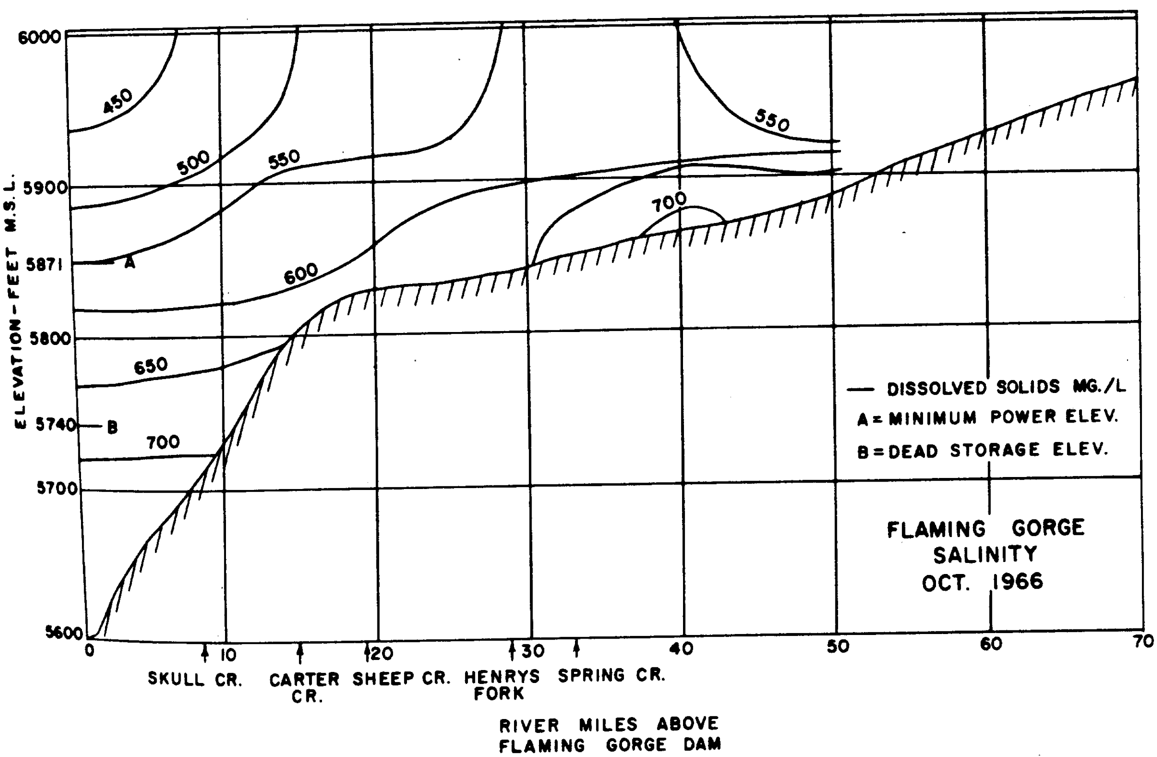
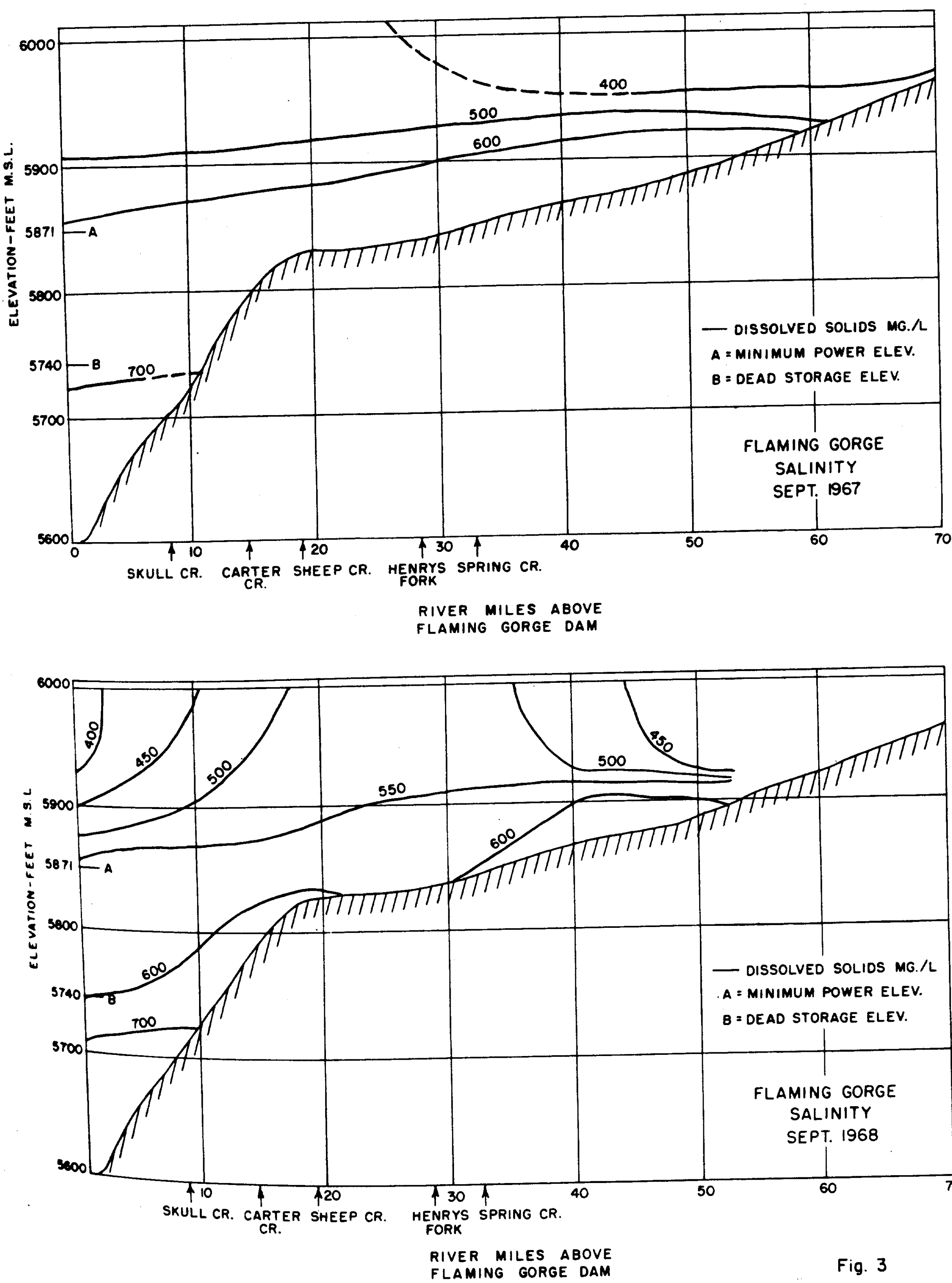

6000
5900
5871 — A
5800
5740 — B
5700
5600
ELEVATION - FEET M.S.L.
450
500
550
600
650
700
550
700
— DISSOLVED SOLIDS MG./L
A = MINIMUM POWER ELEV.
B = DEAD STORAGE ELEV.
FLAMING GORGE
SALINITY
OCT. 1966
0
10
20
30
40
50
60
70
SKULL CR.
CARTER CR.
SHEEP CR.
HENRYS FORK
SPRING CR.
RIVER MILES ABOVE
FLAMING GORGE DAM

Fig. 2


6000
5900
5871 — A
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5740 — B
5700
5600
ELEVATION–FEET M.S.L.
400
500
600
700
— DISSOLVED SOLIDS MG./L
A = MINIMUM POWER ELEV.
B = DEAD STORAGE ELEV.
FLAMING GORGE
SALINITY
SEPT. 1967
0 10 20 30 40 50 60 70
SKULL CR.
CARTER CR.
SHEEP CR.
HENRYS FORK
SPRING CR.
RIVER MILES ABOVE
FLAMING GORGE DAM
6000
5900
5871 — A
5800
5740 — B
5700
5600
ELEVATION–FEET M.S.L.
400
450
500
550
600
700
— DISSOLVED SOLIDS MG./L
A = MINIMUM POWER ELEV.
B = DEAD STORAGE ELEV.
FLAMING GORGE
SALINITY
SEPT. 1968
10 20 30 40 50 60 70
SKULL CR.
CARTER CR.
SHEEP CR.
HENRYS FORK
SPRING CR.
RIVER MILES ABOVE
FLAMING GORGE DAM

Fig. 3

from runoff. The data used to arrive at the above figures are not seasonally continuous and they cover only a short period of time (1957-66). The chemical quality of the major inflowing tributaries (Green River at Green River, Wyo., Blacks Fork at Little America, Wyo., and Henrys Fork at Linwood, Utah) has been measured since 1952, but the flow at Greendale has been observed only since 1957 after construction began; thus the relationship used to estimate unmeasured inflow is not precise. For these reasons the figures should be considered as estimates only. The difference of 800,000 tons between the measured load and the theoretical load represents the estimated amount of dissolved solids added to the river system by leaching during the first 4 years after closure of the reservoir.

The load of dissolved solids in the reservoir measured in September 1968, 2 years later, was about 1,500,000 tons. Starting with 1,850,000 tons of total dissolved solids in storage on October 1, 1966, the theoretical load, or the total amount of dissolved solids, which should have been in the reservoir as the result of runoff, was about 1,100,000 tons. Thus, in the 2-year period ending in September 1968, the amount of dissolved solids leached from the inundated area was about 400,000 tons, or one-half the amount leached in the previous 4-year period. On the basis of these calculations, it would appear that the rate of leaching has not decreased significantly over the first 6 years since the reservoir was closed.

The major observable changes in chemical composition occurring in the reservoir are an increase in the percentage of sulfate and a decrease in the percentage of bicarbonate compared with the chemical composition of the inflow. The inflowing water during the 1963-66 period contained about equal percentages of sulfate and bicarbonate ions (47 percent of the total anions). The water in the reservoir on October 1, 1966, contained about 34 percent bicarbonate and 57 percent sulfate. The percentage of the other ions has remained about the same. The change in the percentage of bicarbonate and sulfate ions relative to the other ions in solution may be the result of leaching of gypsum ($CaSO_4 \cdot 2H_2O$) and other sulfate soluble evaporites from the inundated areas and of precipitation of calcium carbonate ($CaCO_3$).

The chemical composition of water in the reservoir itself, although it is different from that of the inflow, is very uniform. The dissolved-solids concentration shows a definite increase with depth, but the percentage of individual ions is essentially the same throughout the major portion of the reservoir.

Quality of inflow waters.--The major inflow to the reservoir is from Green River which contributes 70-95 percent of the water, but only 55-65 percent of the inflow load of dissolved solids. Because of their higher concentrations of dissolved solids, Blacks Fork and Henrys Fork contribute a higher percentage of the dissolved-solids load than they do of water.

The minor tributaries contribute less than 10 percent of the total inflow to the reservoir and account for less than 15 percent of the total incoming load. The streams draining into the upper part of the reservoir above Henrys Fork are mostly intermittent. The total amount of water they contribute is small, but they are high in dissolved-solids content. Carter Creek, Cart Creek, and Sheep Creek, which drain into the lower section of the reservoir from mountainous areas, contribute larger amounts of water but are more dilute.

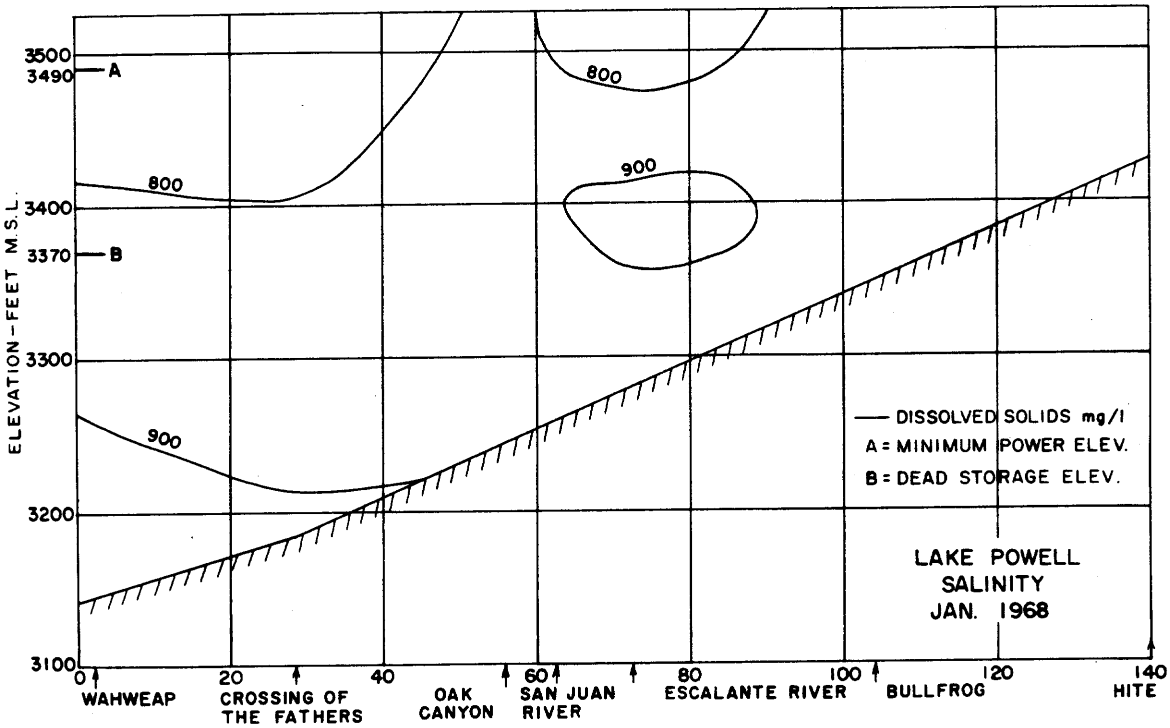
Effects of closure on the Green River at Greendale.--The closure of Flaming Gorge Dam has been too recent (November 1962) to allow a statement as to its ultimate effect on the chemical quality of the water downstream. Data for the first 7 years since closure indicate an initial increase in the average dissolved-solids concentration of the water at Greendale. The highest weighted-average dissolved-solids concentration occurred in 1963 when a minimum of water was being released as the reservoir filled. During the next 6 years (1964-68) the annual weighted-average dissolved-solids concentrations were less than in 1963 but greater than during the 6 years preceding closure. Information is not available on the chemical quality of the water below the reservoir prior to 1957 when construction of the dam began. Construction operations from 1957 to 1962 probably had some effect, and the concentration and load of dissolved solids in the Green River prior to the beginning of construction may have been slightly different from that for the 1957-62 period.

The annual weighted-average concentrations of all major constituents have increased in the water at Greendale since closure of the reservoir with sulfate having the most pronounced increase. The percentage composition (in milliequivalents per liter) of calcium, magnesium, sodium, and chloride has remained about the same after closure as before closure. However, the percentage of bicarbonate has decreased, while that of sulfate has increased. These changes in composition are due to chemical changes in the reservoir as previously discussed.

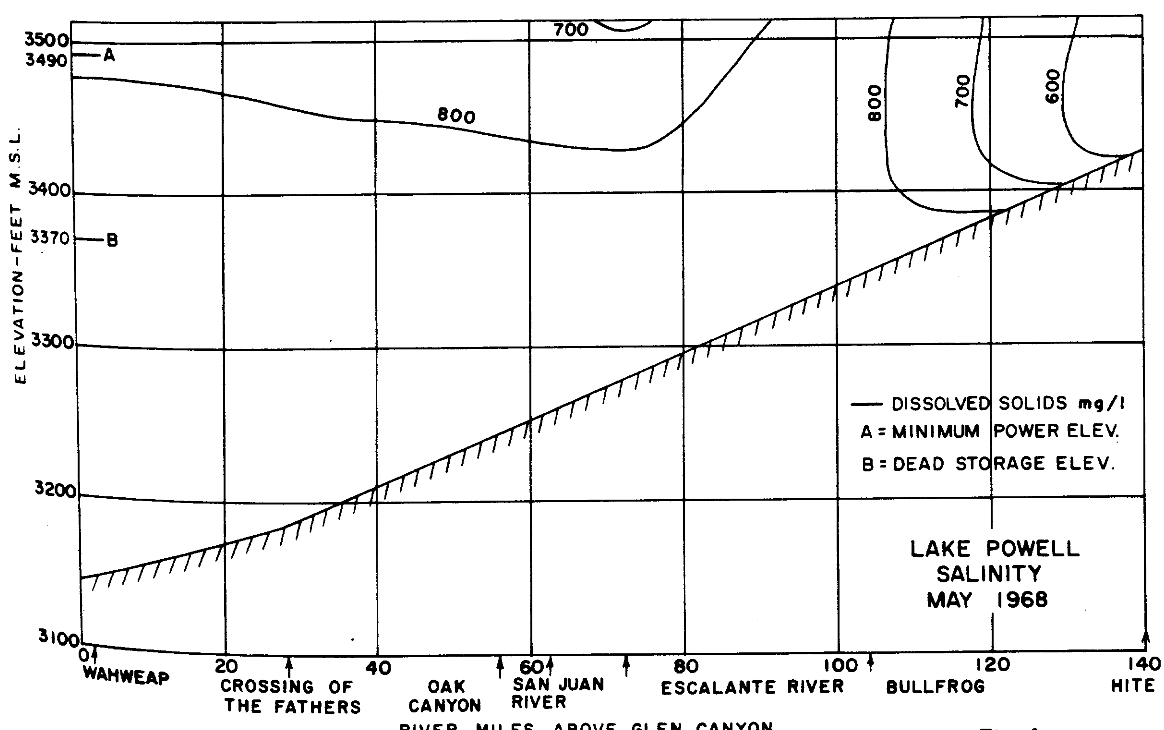
2. Lake Powell

Quality of water in reservoirs.--Water quality studies were started by the Bureau of Reclamation at Lake Powell in January 1965 as the lake was approaching inactive storage level. The program is to collect and analyze water samples four times a year at seven different locations. January, May, July, and October are designated as the months of collection and in addition samples are taken once a month at the mouth of Wahweap Creek. The samples are taken at 50-foot intervals to the bottom of the lake. Results of the sampling for 1968 are shown on the accompanying isohaline graphs. (Figures 4 and 5.)

The graphs show that for any point in the reservoir the salt concentration generally increases with depth. The exceptions are probably caused by colder-less saline water flowing under the warmer-more saline

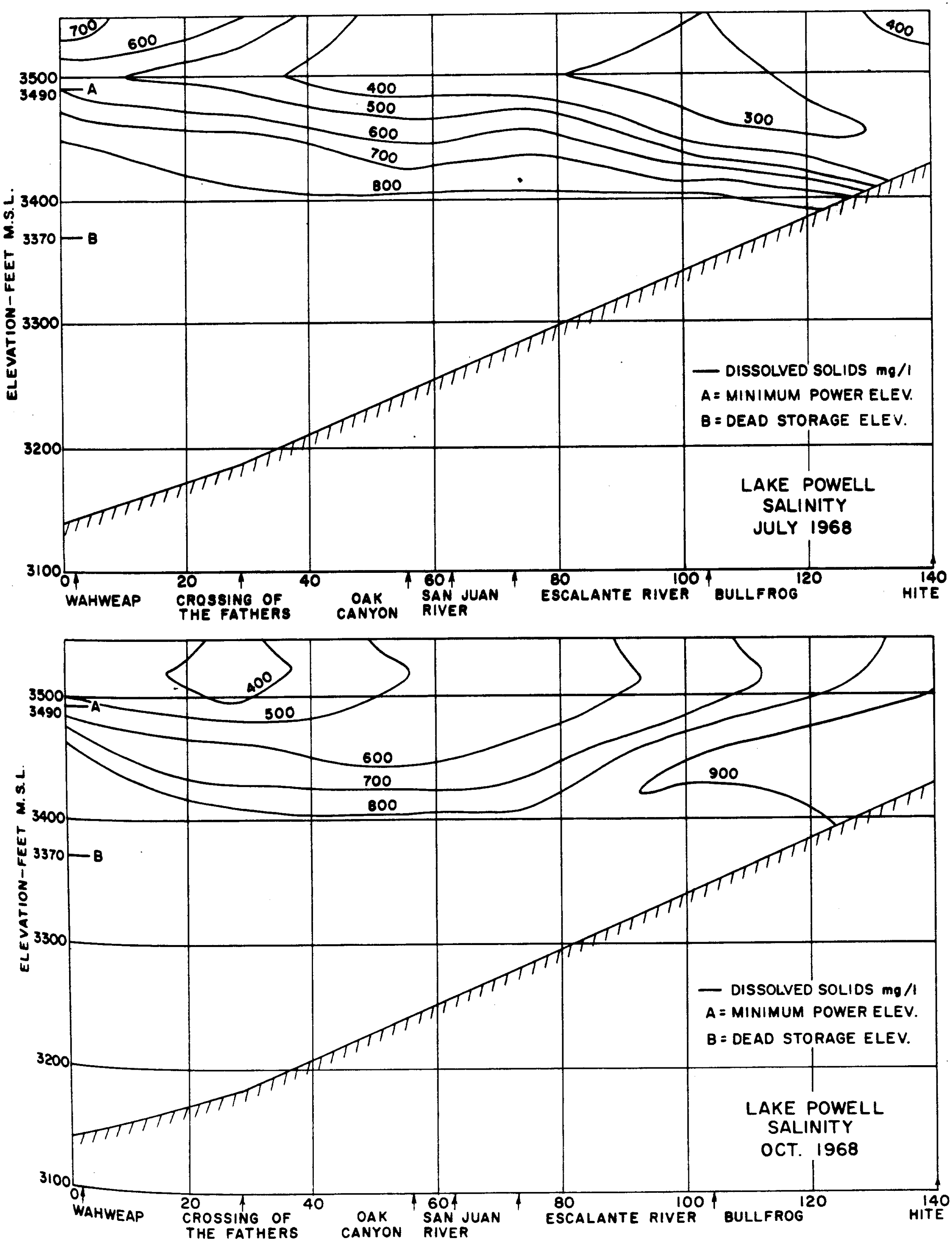


ELEVATION-FEET M.S.L.
3500
3490
A
3400
3370
B
3300
3200
3100
800
900
800
900
DISSOLVED SOLIDS mg/l
A = MINIMUM POWER ELEV.
B = DEAD STORAGE ELEV.
LAKE POWELL
SALINITY
JAN. 1968
0
20
40
60
80
100
120
140
WAHWEAP
CROSSING OF THE FATHERS
OAK CANYON
SAN JUAN RIVER
ESCALANTE RIVER
BULLFROG
HITE



ELEVATION-FEET M.S.L.
3500
3490
A
3400
3370
B
3300
3200
3100
700
800
800
700
600
DISSOLVED SOLIDS mg/l
A = MINIMUM POWER ELEV.
B = DEAD STORAGE ELEV.
LAKE POWELL
SALINITY
MAY 1968
0
20
40
60
80
100
120
140
WAHWEAP
CROSSING OF THE FATHERS
OAK CANYON
SAN JUAN RIVER
ESCALANTE RIVER
BULLFROG
HITE
RIVER MILES ABOVE GLEN CANYON

Fig. 4



RIVER MILES ABOVE GLEN CANYON

Fig. 5

water without mixing. The January graph shows the concentration near the surface of the reservoir generally increasing toward the upper end of the reservoir, probably resulting from the more saline flows of summer and fall from the Colorado and Green Rivers. As the winter and spring flows with less concentration enter the reservoir, the May chart shows the higher concentrated water above the Escalante River becomes diluted. The July chart shows the less saline flows of the high runoff from the Colorado and Green Rivers have moved down the reservoir, flowing mainly over the more saline water already in storage. Also the July chart shows the beginning of the more saline summer flows entering the reservoir. The October chart shows the less saline flows have moved farther down the reservoir, diluting the more saline water slightly. It also shows the more saline summer and fall flows from the Colorado and Green Rivers moving into the reservoir and flowing under the less saline waters. This is one interpretation of the data from the sampling program. The isohaline graphs could be drawn slightly different for other interpretations of the data.

The concentration of the flow in the river below the dam when compared with the concentration at Wahweap for the minimum power elevations indicates that some of the water passed through the powerplant penstock comes from the more concentrated water from lower elevations.

Effects of closure on the Colorado River at Lees Ferry.--The discharge-weighted, average concentration of dissolved solids in the water from the Colorado River at Lees Ferry for the 1941-62 period was a function of the river discharge. This relation is shown in Figure 6 . However, since 1962 this relation has been affected by storage of water in Lake Powell. The concentrations of dissolved solids at Lees Ferry were higher than would have been expected without storage during the first 3 years of regulation and were lower than expected during the ensuing 2 years (1966-67).

By adjusting the discharge at Lees Ferry for storage in Lake Powell beginning with 1963, the dissolved-solids concentration that would have been expected without storage was obtained from the established dissolved-solids discharge relation. The tabulation on page 26 shows the measured and adjusted discharges and measured and expected weighted-average dissolved-solids concentrations for the Colorado River at Lees Ferry for the period 1963-68. (The data for 1968 are preliminary.)

RELATION BETWEEN ANNUAL AVERAGE STREAMFLOW
AND DISSOLVED SOLIDS CONCENTRATIONS 1941-68
COLORADO RIVER AT LEES FERRY, ARIZONA

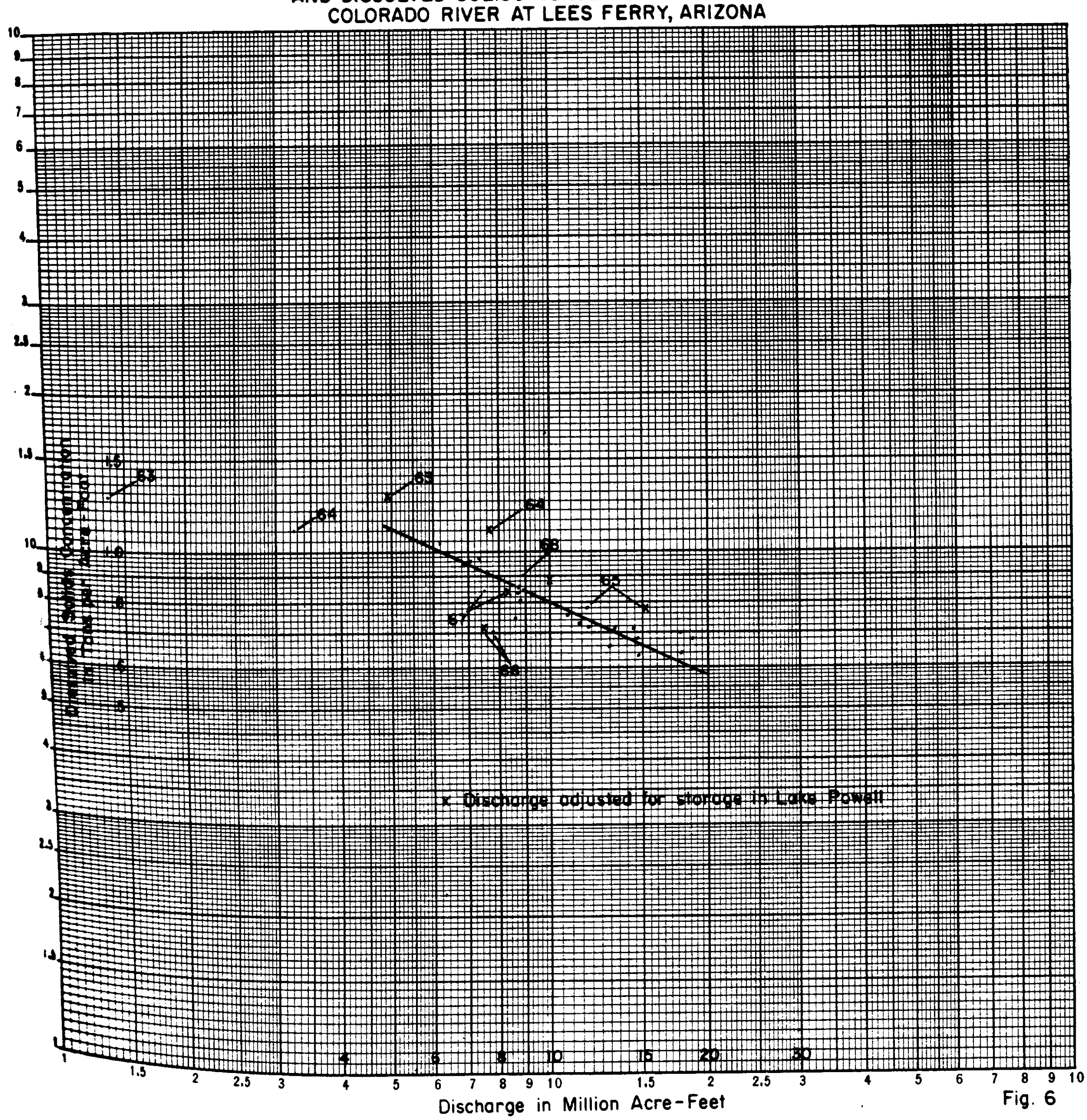


Fig. 6

Colorado River at Lees Ferry

Calendar year	Expected (mg./l.)	Expected tons per acre-foot	Historical (mg./l.)	Historical tons per acre-foot	Discharge (million acre-feet) Adjusted	Discharge (million acre-feet) Historical
1963	825	1.12	935	1.27	4.94	1.38
1964	675	.92	810	1.10	7.68	3.24
1965	485	.66	575	.78	15.15	11.59
1966	675	.92	515	.70	7.60	7.74
1967	650	.88	625	.85	8.45	7.56
1968	560	.76	650	.88	10.14	8.78

The data from the above tabulation plotted in Figure 6 show that during the filling of the reservoir (1963-65) the measured concentrations of dissolved solids in the water released from the reservoir were greater than would have existed without the storage. However, during 2 years of withdrawing water from storage, 1966-67, the measured concentrations were less than the expected.

The concentration in years subsequent to the start of regulation is influenced by the concentration of the water already in storage and the degree of stratification in the reservoir, as well as runoff conditions in the given year. Thus it is believed the concentrations at Lees Ferry in 1963, 1964, and 1965 were somewhat higher than would have been expected without storage because of initial storage of water of higher than average concentrations in 1963, relatively low runoff in 1963 and 1964, and because the water released contained a higher concentration of dissolved solids than the average concentration of dissolved solids of the water in storage owing to salinity stratification in the reservoir.

The rather large reduction in outflow concentration occurring in 1966 resulted from the diluting effect of the unusually high inflow of dilute water during the spring runoff period of 1965.

The increase in concentration of outflow water in 1967 resulted because total inflow and the ratio of spring inflow to total flow in both 1966 and 1967 was lower than in 1965.

The effects of evaporation and chemical precipitation due to Lake Powell cannot yet be clearly evaluated.

Experience is too short at this time to define a concentration-discharge relation at Lees Ferry subsequent to the closing of Glen Canyon Dam. In fact, one should not expect a close correlation between concentration and discharge at Lees Ferry. There will always be a lag in the response of concentration of outflow water at Glen Canyon Dam to inflow conditions due to storage and stratification in the reservoir. This is borne out by experience below Hoover Dam.

3. Lake Mead

The Bureau of Reclamation conducted an extensive quality sampling program of Lake Mead from 1964 through 1968. As many as 28 stations were sampled in the spring and fall. Tests were made for dissolved oxygen, carbon dioxide, pH, alkalinity, temperature, conductivity, and turbidity at selected depths at each station. Water samples were obtained from selected depths for laboratory analysis for calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphate, chloride, nitrate, phosphate, electrical conductivity, total dissolved solids, and pH. The results of these investigations were correlated with the sampling station at Hoover Dam where monthly water analyses of many of these factors have been made for over 20 years. The data collected from the sampling program during the period April 1964 through November 1966 were published in Report No. CHE-70, Water Quality Study of Lake Mead, November 1967, Bureau of Reclamation, Denver, Colorado.

This report documents the effect of the reduced inflow on water quality and the improvement of quality with increased inflow to the lake following the initial filling of Lake Powell.

The report discusses the limnological characteristics of Lake Mead. The annual temperature cycle of Lake Mead is classified as warm monomictic in that the temperature is never below 39.2° F., undergoes circulation during the winter, and is directly stratified in the summer.

There is an increase in mineral content from the upper to the lower end of Lake Mead with the greatest increases being in sulphates and chlorides of calcium and sodium. The only decrease noted was in the bicarbonate values.

It is expected that the type of sampling made during this survey will be repeated at appropriate intervals in the future.

C. Lower Colorado River Salinity Investigations

Water quality data from 58 locations in the Lower Colorado River Basin are being used in a special study instituted by the Bureau of Reclamation in 1970 to more clearly define the sources of salinity contribution between Parker Dam and Imperial Dam. To acquire the necessary data for the study, the sampling frequency was increased to obtain daily specific conductance, weekly TDS analyses by evaporation, and monthly chemical analyses at 10 stations as follows: Colorado River below Parker Dam; Colorado River Indian Reservation Main Canal near Parker; Poston Wasteway near Poston; Colorado River Indian Reservation Levee Drain near Parker; Palo Verde Canal near Blythe; Colorado River Indian Reservation

Lower Main Drain near Parker; Colorado River at Taylor Ferry near Cibola; Palo Verde Irrigation District Outfall Drain near Palo Verde; Colorado River below Cibola Valley; and Colorado River at Imperial Dam.

D. Natural Sources of Salinity

Inspection of the flow and quality records reveals that along certain reaches of the Colorado River there are large increases in the dissolved-solids load that cannot be attributed to irrigation. This increase is mainly due to natural diffused sources and the saline springs and wells in the Colorado River Basin. Although wells are man-made and not a natural source, abandoned saline flowing wells are also presented in this section.

1. Diffused Sources

Natural diffused sources are those sources of salt contribution which occur gradually over long reaches of the river system.

Salt pickup occurs over large areas of surface and underlying soils, from stream channels and banks, and is difficult to identify, measure, or control. This source contributes the largest overall share of the salts to the Colorado River. Natural point sources are mainly saline springs where the contribution of salt and water is easily identified, issuing from single or concentrated sources.

Past records indicate an increase in salt load in the Lake Powell area above Lees Ferry and below the Green River, Cisco, and Bluff stations. Iorns and others (1965, p. 20) presented estimates of dissolved-solids loads in this river reach based on the period 1914-57 adjusted to 1957 conditions of development. Unaccounted inflow of dissolved solids in this reach amounted to about 5 percent of the load at Lees Ferry.

During 3 consecutive years (1949-51) when there was very little increase in water discharge between Lees Ferry and Grand Canyon, the dissolved-solids load increased about 1.3 million tons each year. During 1951 the discharge increased by about 1 million acre-feet, but the load increased by only 2 million tons. In 1952 the discharge increased by 0.2 million acre-feet and the load by 2.2 million tons. With the exception of these 2 years the annual increase in dissolved-solids load during the 28-year period has ranged from 0.5 million tons to 1.8 million tons.

In 1962 runoff of 14.4 million acre-feet at Lees Ferry increased by [illegible]00,000 acre-feet at Grand Canyon and the dissolved-solids load increased by half a million tons. By contrast, during the filling of Lake Powell the following year, only 1,384,000 acre-feet was recorded at Lees Ferry and the increase in flow at Grand Canyon amounted to 246,000 acre-feet, but the dissolved-solids load still increased by more than a half million tons. Likewise, with a small flow in 1964 the dissolved-solids load increased by nearly 900,000 tons.

Large amounts of dissolved solids also are added to the Colorado River between Grand Canyon and Hoover Dam. This does not result entirely from the solution of material in the bed of Lake Mead, but definition of specific sources along this reach of the river is difficult.

Very little information was obtained prior to irrigation and therefore more studies are needed to identify the magnitude of specific natural sources of salinity in the Colorado River Basin.

2. Contribution of Salts to the River System by Springs and Tributaries

Tables A and B summarize information about the contribution of water and dissolved salts by springs and wells to the Upper Colorado River system. The largest contributors in the Upper Basin are the Dotsero and Glenwood Springs which supply the major part of the salts from point sources. Recent studies in the Lower Basin by the Geological Survey and the Bureau of Reclamation have provided information about the contribution of springs to the Colorado River between Glen Canyon Dam and Lake Mead and to the Virgin River which drains into Lake Mead. The results of these studies are presented in the following paragraphs.

Between Glen Canyon Dam and Lake Mead numerous springs and small spring-fed tributary streams, as well as several large streams, contribute water and dissolved solids to the Colorado River. The largest contributors of dissolved solids are the Paria and Little Colorado Rivers and Bright Angel, Tapeats, Kanab, and Havasu Creeks. Records summarized in this report for the hydrologic data stations on the Colorado River at Lees Ferry (just upstream from Paria River) and near Grand Canyon (just upstream from Bright Angel Creek) indicate that each year slightly more than a million tons of dissolved solids are added to the Colorado River in this reach alone. About half of this increase can be attributed to springs in the lower 13 miles of the channel of the Little Colorado River. The Virgin River salinity contribution is principally from the LaVerkin Springs about 40 miles northeast of Littlefield, Arizona.

Paria River.--Iorns and others (1965, Table 10, p. 346) estimated that the Paria River contributed about 34,000 tons of dissolved solids and 23,000 acre-feet of water annually to the Colorado River. Their estimates were based on the period 1914-57, adjusted to 1957 conditions of development. For the 1941-68 period the average annual contribution is about 30,000 tons of dissolved solids and 18,800 acre-feet of water. Sulfate, calcium, sodium, and magnesium are the major dissolved constituents making up this dissolved-solids discharge.

Table A
Mineral and Saline Springs
Upper Colorado River Basin1/

Spring and location	Flow (c.f.s.)	SO_4 (mg./l.)	Cl (mg./l.)	Total dissolved-solids concentration (mg./l.)	Total dissolved-solids concentration (tons/ac.-ft.)	Total dissolved-solids load tons/day	Total dissolved-solids load tons/year	Flow (ac.-ft./year)
Castle Creek Spring near Moab, Utah	0.245	1,290	1,460	4,390	6.0	2.9	1,060	177
Onion Creek Spring near Moab, Utah	0.122	1,830	4,000	9,120	12.4	3.0	1,100	88
Cold Kendall Spr. nr. Kendall Ranger Sta., Wyo.	1.400	1,300	1	2,100	2.8	7.9	2,880	1,014
Ragen Spring on Muddy Cr. west of Ft. Bridger, Wyo.	0.089	1,620	3,380	9,210	12.6	2.2	800	64
Dotsero Sprs. 1.5 mi. west of Dotsero, Colo.	17.000	450	5,800	10,700	14.5	500.0	182,600	12,308
Glenwood Sprs. area, Glenwood Sprs., Colo.	18.000	1,150	10,000	18,900	25.5	919.0	335,000	13,032
Steamboat Sprs. at Steamboat Sprs., Colo.	1.400	615	1,400	6,140	8.4	23.4	8,500	1,014
Lithia Spring, Steamboat Sprs., Colo.	0.022	460	1,350	5,770	7.8	0.3	110	16
Piceance Creek Spring, Meeker, Colo.	0.022	401	632	4,650	6.5	0.2	72	16
Trimble Hot Spring, Durango, Colo.	0.066	1,010	240	3,250	4.4	0.1	36	48
Pagosa Hot Spring, Pagosa, Colo.	2.300	1,500	173	3,240	4.4	20.0	7,300	1,665
Pinkerton Hot Spring, Durango, Colo.	0.500	635	1,010	3,670	5.0	5.0	1,820	362
Yellow Creek Spring, Rangely, Colo.	0.089	58	750	9,370	12.7	2.3	840	64
Ridgway Hot Spring, Ridgway, Colo.	1.000	1,460	103	2,850	3.9	7.0	2,550	724
Paradise Hot Spring, Dunton, Colo.	0.111	134	2,800	5,490	7.5	1.7	620	80
Big Sulphur Spring, Meredith, Colo.	0.333	1,390	1	2,250	3.1	2.0	730	241
Arsenic Spring, Crystal Mining Camp	2.000	1,350	2	2,030	2.8	11.0	4,000	1,448
Coal Mine Drainage, Oak Creek, Colo.	0.666	1,960	4	3,430	4.7	6.2	2,260	482
Seepage to Big Sandy Cr., Farson, Wyo.	0.133	3,340	37	5,600	7.6	2.0	730	96
Total	45.498					1,516.2	553,008	32,939

1/ List of springs limited to those with T.D.S. concentrations in excess of 2,000 mg./l.

Table B
Mineral and saline wells
Upper Colorado River Basin

Spring and location	Flow (c.f.s.)	SO_4 (mg./l.)	Cl (mg./l.)	Total dissolved-solids concentration (mg./l.)	Total dissolved-solids concentration (tons/AF)	Total dissolved-solids load (tons/day)	Total dissolved-solids load (tons/year)	Flow (acre-feet/year)
South Drain, Ashley Creek Oil Field, Vernal, Utah	2.200	1,540	96	2,670	3.6	15.9	5,800	1,593
Crystal Geyser, Green River, Utah	.282	2,430	4,560	13,100	17.8	10.0	3,640	204
Oil Test Hole, Meeker, Colorado1/	3.100	3,010	8,720	18,900	26.0	160.0	58,400	2,244
Flowing Well near Aneth, Utah	.133	1,980	763	4,560	6.2	1.6	580	96
Flowing Well 13.1 miles above mouth of Piceance Creek1/	.355	11	554	17,900	24.4	17.2	6,280	257
Drainage, Iles Dome Oil Field near Loyd, Colorado	2.900	39	137	2,180	2.9	17.0	6,200	2,100
Total	8.970							6,494

1/ Plugged in summer of 1968.

Little Colorado River.--The water discharge of the Little Colorado River near Cameron, Arizona, which is above Blue Spring, has ranged during 1948-68 period from 19,260 acre-feet in 1956 to 347,600 acre-feet in 1952. The average for the 21-year period is 148,000 acre-feet. An estimated annual dissolved-solids discharge of 130,000 tons appears reasonable for the Little Colorado River Basin upstream from Blue Spring. This estimate is based on chemical-quality records collected at Cameron which is upstream from the gaging station and from Moenkopi Wash.

Blue Spring is in the bed of the Little Colorado River about 13 miles upstream from its mouth at approximately 36°07' N. latitude and 111°42' W. longitude. Other springs discharge into the channel of the Little Colorado River throughout a 10-mile reach downstream from Blue Spring. Measurements of water discharge near the mouth of the Little Colorado River made at times when the river was dry at the gaging station near Cameron, Arizona, (mile 45.5) indicate that the combined flow of the springs is constant. The average discharge, based on 10 measurements from June 1952 to May 1966, was 222 cubic feet per second. This discharge results in a contribution of 161,000 acre-feet of water annually and 547,000 tons of salt to the Colorado River.

Bright Angel Creek.--Bright Angel Creek enters the Colorado River just downstream from the hydrologic data station near Grand Canyon. The average annual water discharge (45 years of record) of Bright Angel Creek at its mouth is 25,410 acre-feet and is mostly from springs near the North Rim of the Grand Canyon. The base flow has been estimated as 15,000 acre-feet per year. Records of water quality indicate that the average dissolved-solids concentration is about 0.27 ton per acre-foot and that calcium, magnesium, and bicarbonate are the major dissolved constituents. The annual contribution of dissolved solids from Bright Angel Creek to the Colorado River is about 7,000 tons.

Tapeats Creek.--Tapeats Creek is fed by springs in its headwaters and by Thunder Spring, the source of water for its major tributary, Thunder River. Simultaneous measurements of water discharge at the mouth of Tapeats Creek and at the mouth of Bright Angel Creek indicate a good correlation of streamflow (R. B. Sanderson, written communication, 1963) and thus permit application of the long-term streamflow record for Bright Angel Creek to estimate the discharge of Tapeats Creek. By use of this correlation the average annual discharge of Tapeats Creek is estimated to be about 58,000 acre-feet.

Only few determinations of water quality of Tapeats Creek at its mouth have been made. These data indicate that the water is of the calcium, magnesium, bicarbonate type, and is of low mineralization.

The average dissolved-solids concentration of water at its mouth computed from the few measurements is about 0.2 ton per acre-foot. On this basis Tapeats Creek contributes about 12,000 tons of dissolved solids annually to the Colorado River.

BASIC STUDIES

Kanab Creek.--Kanab Creek has a drainage area of about 1,600 square miles, of which about 1,000 square miles is in southern Utah. A few miscellaneous measurements of water discharge and water quality have been made at the mouth of Kanab Creek. Calcium, magnesium, and sulfate are the principal dissolved constituents.

Based on these measurements the estimated base flow of Kanab Creek at its mouth is about 4 c.f.s. and the corresponding dissolved-solids concentration is about 1.5 tons per acre-foot. The minimum annual contribution of dissolved solids from Kanab Creek to the Colorado River on this basis is estimated to be 4,500 tons.

Havasu Creek.--Havasu Creek drains the Coconino Plateau south of the Colorado River and enters the river about 13 miles downstream from Kanab Creek. Two determinations of water quality at the mouth of Havasu Creek indicate that the water is of the calcium, magnesium, bicarbonate type and that its dissolved-solids concentration is about 0.5 ton per acre-foot. Ten measurements have indicated a base flow of about 65 c.f.s.

If the base flow of Havasu Creek is 65 c.f.s. (47,000 acre-feet per year) and the average dissolved-solids concentration is 0.5 ton per acre-foot, a minimum annual contribution of 24,000 tons of dissolved solids can be estimated to reach the Colorado River from Havasu Creek.

Other tributaries between Glen Canyon Dam and Lake Mead.--Many small springs and spring-fed tributaries also contribute dissolved solids to the Colorado River, but information about the water discharge and chemical quality of these inflows is sparse. In recent years, however, several parties of Interior Department scientists and engineers have made observations of water discharge and collected water-quality data during trips down the Colorado River.

Virgin River.--The dissolved-solids discharge of the Virgin River at Littlefield, Arizona, is about 350,000 tons per year (see Table 14). Although much of the water and dissolved solids is diverted for irrigation between Littlefield and the mouth of the river in Lake Mead, the dissolved solids eventually reach Lake Mead.

Of the springs which discharge into the Virgin River and its tributaries, the largest contributor of dissolved solids probably is LaVerkin Springs ("Dixie Hot Springs"). These warm (105-107° F.) springs discharge into the river in a reach several hundred yards long about 40 miles northeast of Littlefield, Arizona. Some of the springs rise in the bed of the river, and others discharge from the sides of the canyon walls in the Hurricane Fault zone.

In recent years several measurements of water discharge have been made just downstream from the springs when the entire flow of the Virgin River upstream from the springs was being diverted. These measurements ranged from 10 to 11 c.f.s. and indicate that the flow of the springs does not vary appreciably. The chemical quality of the combined spring inflow is also relatively constant.

The annual contribution of LaVerkin Springs is estimated as 7,700 acre-feet of water and 98,000 tons of dissolved solids which include principally sodium (26,000 tons), sulfate (22,000 tons), and chloride (38,000 tons).

Summary of contribution by springs and tributaries below Glen Canyon Dam.--Major springs and spring-fed tributaries annually contribute a minimum of almost 800,000 tons of dissolved solids to the Colorado River between Glen Canyon Dam and Lake Mead. Storm runoff in small tributaries in this reach of the Colorado River contribute an unknown, but probably much smaller, load to the river. The contribution of dissolved solids by major sources of inflow between Glen Canyon and Lake Mead equals about 10 percent of the average dissolved-solids load of the Colorado River at Lees Ferry. Springs in the lower Little Colorado River contribute about half of the measured increase in dissolved-solids discharge in the Colorado River between Lees Ferry and Grand Canyon.

LaVerkin Springs discharge almost 100,000 tons of dissolved solids annually to the Virgin River; this contribution is about one-fourth of the measured dissolved-solids discharge of the Virgin River at Littlefield, Arizona.

The annual dissolved-solids contributions of major springs, streams, and spring-fed tributaries to the Colorado River between Glen Canyon Dam and Lake Mead and to the Virgin River are summarized in Table C .

Table C

Contribution from major springs and tributaries between Glen Canyon and Hoover Dams

Source	Dissolved-solids discharge in thousands of tons per year
Paria River	30
Little Colorado River above Blue Spring	130
Springs in Lower Little Colorado River	550
Bright Angel Creek	7
Tapeats Creek	12
Kanab Creek (base flow)	4
Havasu Creek (base flow)	24
Total inflow in Colorado River (Glen Canyon Dam to Lake Mead)	757
LaVerkin Springs (inflow to Virgin River)	98
Total inflow to Colorado and Virgin Rivers	855

The minimum annual inflow of 855,000 tons from these sources results in an increase in dissolved-solids concentration of about 47 milligrams per liter (0.06 ton per acre-foot) in the Colorado River on the basis of an annual flow of 11 million acre-feet.

E. Agricultural Sources of Salinity

It is anticipated that development of new irrigation projects may increase the total dissolved solids in the Colorado River. Return flows from the irrigated lands pick up salts from the soils and underlying shales and transport them to the river system.

Studies in the basin thus far have been limited to a comparison of total dissolved solids in the inflowing water and the return flow water. Until recently no attempt had been made to determine losses of water or total dissolved solids by deep percolation, to detect underground aquifers that might be augmented with return flow, or to evaluate changes in chemical characteristics (other than total dissolved solids) resulting from development.

Studies prior to irrigation would be helpful, but they have not been made in most areas, so comparisons must be made when new land is added or new storage is made available. The Seedskadee Project area may present a comparison between "before" and "after" irrigation conditions after several years of full irrigation on the lands.

Salt balance conditions exist when the amount of dissolved solids carried off the land is equal to that amount added. Pickup of salt as used in this report represents an unbalanced condition shown by the increase of total dissolved-solids load in the runoff over the total load in the applied water. This pickup from an area could result from natural sources, such as precipitation runoff, and/or irrigation return flows. Salt pickup chargeable to irrigation would be only that additional which occurs as a result of irrigation and should not include the amount of prior pickup off the land resulting from natural sources.

The small amount of data presently available gives indications of much variation in the amount of pickup from land due to irrigation. The estimated salt pickup in this report is based on values of zero and 2 tons from newly irrigated land. Zero or minimum conditions occur generally after initial leaching in areas where soils are loose and contain very little salt. The 2 tons per acre was selected as the higher end of the range for the average pickup over a project area. It was also assumed in this report no additional pickup would result from water applied to presently irrigated lands.

Quality of water studies have been made in several areas to determine storage and irrigation effects on water quality. Three of these worthy of mention are the Florida Project, Vernal Area, and Eden Project and are described in the following paragraphs:

1. Florida Project

Construction of the Florida Project was completed in 1965. The Lemon Reservoir on Florida River regulates the flow of the river for irrigation of 19,450 acres of land including 5,730 acres not previously irrigated and 13,720 acres in need of supplemental water.

In order to obtain quality information under preproject conditions, flow and quality data were collected at several points in the Florida Project area beginning in 1958. A study has been made of these data for the period 1958-63 to show the effect irrigation of these lands has on the quality of return flows leaving the project under the condition of no storage.

An attempt was made in this study to measure the effect of irrigation in the Florida area on the quality of water in the Animas River below its confluence with the Florida River. It was found that the difference in concentration, however, is scarcely discernible and is within the limits of error of measurement of both flow and quality.

Florida Project, Colorado

Year	Acre-feet or tons	Inflow	Outflow	Difference	Pickup (tons/acre)	Loss (tons/acre)
1958	A.F.	99,800	90,360	9,440		
	Tons	14,315	15,470	+1,155	0.08	
1959	A.F.	28,260	14,300	13,960		
	Tons	4,900	4,365	525		0.04
1960	A.F.	73,130	60,600	12,530		
	Tons	10,600	11,730	+1,130	0.08	
1961	A.F.	58,490	41,430	17,060		
	Tons	9,100	8,970	130		0.01
1962	A.F.	67,070	48,470	18,600		
	Tons	10,220	10,220	0	0	
1963	A.F.	45,800	33,750	12,050		
	Tons	7,889	7,100	789		0.06

From the above tabulation it is apparent that there has been a very small amount of pickup measured in the river downstream from the project. The concentration of total dissolved solids in the inflowing water ranges from 0.14 to 0.17 ton per acre-foot, and that of the outflowing water ranges from 0.17 to 0.30. About 13,720 acres were irrigated prior to construction of the project facilities.

Irrigation has been practiced for many years in the Florida area without adverse effects because of the extremely good water and the good drainage conditions.

The Florida Project soils and the adjoining Pine River Project soils are naturally low in salinity and alkalinity, and the amount of dissolved solids removed from these projects is about equal to the amount deposited indicating negligible pickup.

2. Vernal Area

A cooperative research study is being conducted in the Ashley Valley surrounding Vernal, Utah, by the Bureau of Reclamation with financial support provided by the Federal Water Quality Administration. This study is the initial phase of a large-scale research project entitled, "Prediction of Mineral Quality of Return Flow Water from Irrigated Land," which was initiated in the latter part of FY 1969. The primary objective of this project is to develop a digital simulation model which will accurately predict the quantity and quality of irrigation return flows from an entire irrigation project with known soil, groundwater, geologic and hydrologic characteristics. With such a model the water quality impact of a proposed irrigation development including its alternatives could be more accurately assessed. This would allow selection of the optimal design of proposed project features in order to minimize any adverse effects on water quality. Another application would be the evaluation of improvements of irrigation facilities and practices in established irrigated areas aimed at reducing present high salt contributions.

Ashley Valley was selected as the initial study area. Characterization studies of this area are currently underway. Initial runs of an elementary simulation model were made during 1970 using present data. The model will be refined and additional data collected during the next 2 years. Field studies are anticipated at other locations with various soil and geologic profiles to verify the model under a wide range of conditions.

Another project is directed toward the dual objectives of increasing the knowledge of the basic processes controlling the movement of salts in the soils and minimizing salt pickup by return flows. Utah State University initiated this project, "Quality of Irrigation Return Flow," during FY 1969 under a Federal Water Quality Administration research grant. With data from the laboratory and the greenhouse lysimeters, a digital simulation model was developed to predict the movement of salts with the corresponding changes in the quality of applied irrigation water in the soil. Using this model, on-farm irrigation practices and rate and timing of irrigation applications were planned to manage the salinity concentration of soil moisture within acceptable limits for the crop grown and at the same time minimize the salt pickup by the return flows.

The University established a 40-acre test farm near Vernal, Utah, in 1970 and will field test the laboratory model in 1970 and 1971. Results of these tests will be coordinated with the Bureau of Reclamation study in Ashley Valley.

Preliminary results indicate that it may be feasible to seasonally store salts contained in the irrigation water in the deeper soil zones during low streamflow periods and then flush these salts out during higher streamflows, thereby reducing the wide seasonal variations in stream salinity concentrations. With further refinement of the model it is expected that on-farm irrigation practices can be planned to obtain high irrigation efficiencies, a salt balance in the root zone, and also to minimize the pickup of additional salts from the soil profile by the return flows.

3. Eden Project

Quality of water data have been collected in the Eden Project area for the 14-year 1955-68 period. The amount of dissolved solids (as measured in Big Sandy Creek) picked up from project lands area has varied considerably over the years. Because of many variables from year to year in water supply, return flows, irrigated acreages, and other influencing factors, results from this study have not been conclusive. Collection of data should be continued for a few more years during which time attempts should be made for better controls of the influencing factors. Preproject data are very limited making preproject and postproject comparisons impractical.

4. Other Studies

Considerable variation in the effects of irrigation return flow on water quality is to be expected. Differences arise due to the size of the irrigated areas, the number of times the return flow is reused, properties of the soils and drainage area, number of years land has been irrigated, nature of aquifers, rainfall, dilution, temperature, irrigation methods, storage reservoirs, vegetation, and type of return flow channels.

Consumptive use, return flow, and salinity studies are now being conducted by Federal agencies in cooperation with State and local agencies. Some of the study areas are purposely being held small to achieve better control, but they will be as representative as possible of existing projects. The results pertaining to the quantity of return flow will be very helpful in estimating effects on water quality of return flows from larger areas where measurement of inflow and outflow is not always possible or practical.

Special studies in areas of the basin will continue to be made from time to time to determine water quality conditions, and studies of projects, such as Florida, Vernal Area, and Eden, should be repeated or continued in order to evaluate changes with time. The Seedskadee Experimental Farm area was monitored for quality of water for the period 1968 to July 1970. Data are presently being studied to see the effects of irrigation on quality of return flows. Projects which may need additional investigations include the Grand Valley (presently under canal lining study) and Uncompahgre Projects in Colorado and possibly some direct diversion projects along the Colorado River below Hoover Dam, such as Palo Verde Valley and the Colorado River Indian Reservations. An important consideration in quality studies is measurement of return flows because this information is a key factor in evaluating the adequacy of drainage and determining if salts are being accumulated or leached from a project.

F. Municipal and Industrial Sources of Salinity

Salt loads contributed to the Colorado River system by municipal and industrial sources are minor, totalling about 1 percent of the basin salt load. Future increases in salt loads from these sources are expected to be small relative to the total basin salt burden.

Most municipal and industrial wastes have relatively low salinity concentrations and complete elimination of such waste discharges would have little effect on salinity concentrations in the main river system. Since these wastes are point sources of salinity, control of a source could be achieved if salinity levels in the waste being discharged (i.e., industrial brines) warrant such control.

G. Summary of Sources of Salinity

Salinity concentrations in the Colorado River system increase severalfold between the high quality of headwater tributaries and the lower reaches of the river. This increase results from two basic processes--salt loading and salt concentrating. Salt loading, the addition of mineral salts from various natural and man-made sources, increases salinity by increasing the total salt burden carried by the river. In contrast salt concentrating effects result from concentrating the river salt burden in lessor volume of water when streamflow depletions are caused by consumptive use.

Salt loads are contributed to the river system by natural and man-made sources. Natural sources include diffuse sources such as surface runoff and diffuse groundwater discharges, and discrete sources such as mineral springs, seeps, and other identifiable point discharges of saline waters. Man-made sources include municipal and industrial waste discharges and return flows from irrigated lands.

BASIC STUDIES

Streamflow depletions contribute significantly to salinity increases. Consumptive use of water for irrigation is responsible for the largest depletions. Consumptive use of water for municipal and industrial purposes accounts for a much smaller depletion. Evaporation from reservoir and stream surfaces also produces large depletions. Phreatophytes, too, cause significant water losses by evapotranspiration, especially in the Lower Basin below Hoover Dam. Out-of-basin diversions are also a source of streamflow depletions.

PART V. EVALUATIONS OF EXISTING SALINITY CONDITIONS

A. Quality of Water Stations

A primary purpose of this report is to summarize water quality conditions for the Colorado River Basin. This part summarizes mineral quality under both historical and present conditions of water resource development and utilization. Anticipated changes in future mineral quality are discussed in Part VI. Other water quality parameters are discussed in Part IX.

Evaluations of the mineral quality of water in the basin are based on quality of water and streamflow records at 17 selected stations. Each station is considered to reflect flow and water quality conditions at its location. Records were generally available at each station for the time period considered by this report, 1941 to 1968. Where records were not available, missing data were estimated by correlation with other stations.

Basic data summarized in this report were primarily obtained from records of the Geological Survey developed by a continuing program for collection of water data which is supported in part by a transfer of funds from the Bureau of Reclamation.

Locations of the 17 key stations are shown on Figure 1 . Availability of flow and quality records for each station is shown on Figure 7 . The source and method of derivation of basic data for each of the stations are briefly discussed in the following sections.

1. Key Stations with Complete Records

Records of flow and water quality are available for all or nearly all of the 1941-68 period for the Green River at Green River, Utah (Station No. 4); Colorado River near Glenwood Springs, Colorado (Station No. 6); Colorado River near Cameo, Colorado (Station No. 7); Gunnison River near Grand Junction, Colorado (Station No. 8); Colorado River near Cisco, Utah (Station No. 9); and San Juan River near Bluff Utah (Station No. 11). Minor extensions only were needed to fill in short periods of record for a few of these stations. The Glenwood Springs gage was moved from above to below the Roaring Fork at the end of water year 1966. Subsequent Glenwood Springs gage records were adjusted by subtracting the Roaring Fork flows. All records were obtained from the Geological Survey.

2. Key Stations with Partial Records

Green River near Green River, Wyoming (Station No. 1).--Flow records are available at this station from April 1951 and quality records

Colorado River Basin
Flow and Quality of Water Records
1941 – 68

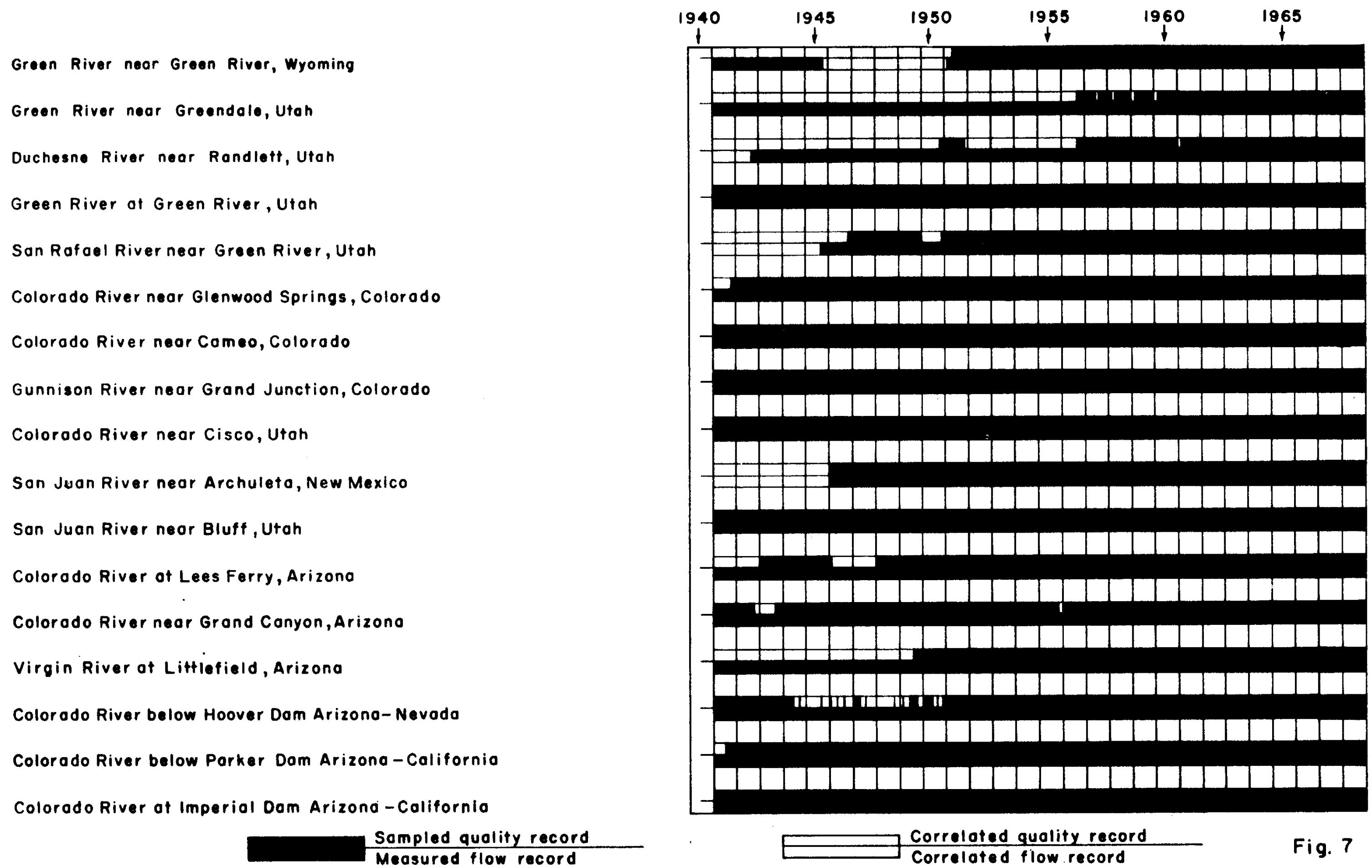


Fig. 7

from May 1951. The records have been extended back to 1941 by correlation with nearby stations.

Green River near Greendale, Utah (Station No. 2).--Flow measurements or comparable data are available for this station for the report period, but chemical quality data are available only for the years 1957 through 1968, inclusive. Extensive correlations with other available records on the Green River system were employed to develop estimates for dissolved solids.

Duchesne River near Randlett, Utah (Station No. 3).--Flow records have been obtained continuously since 1943 and quality data are available for 1951 and 1957 through 1968. Correlations with other stations in the Duchesne River system were employed to estimate the data for the missing period.

San Rafael River near Green River, Utah (Station No. 5).--Correlations were used to estimate flow at this gage from 1941 to 1945 after which measurements of flow were available. Quality sampling started in 1946 and is complete for the remainder of the study period except for 1950. Extensions of available data provided satisfactory estimates of mineral quality for the missing years.

San Juan River near Archuleta, New Mexico (Station No. 10).--For the period 1954 to 1968 flow and quality data presented are a combination of measurements obtained near Archuleta and at Blanco, New Mexico, with a few adjustments and correlations. Correlations were employed to estimate the data for 1941-54.

Colorado River at Lees Ferry, Arizona (Station No. 12).--This station has complete flow records available for the study period but lacks quality of water measurements for 1941, 1942, 1946, and 1947. Quality data for these years were estimated by extensive multiple correlations using data for the Colorado River near Cisco, Utah, and near Grand Canyon, Arizona; the Green River, Utah; and the San Juan River near Bluff, Utah.

Colorado River near Grand Canyon, Arizona (Station No. 13).--Flow records are available for the report period and chemical quality records are also available except for the period December 1942 to August 1943. Quality data for the period of missing records were estimated from records at upstream stations.

Virgin River at Littlefield, Arizona (Station No. 14).--Flow records are available for the report period, but quality data are available only from July 1949 to December 1968. Detailed correlations were employed to estimate the data for the missing period.

Colorado River below Hoover Dam, Arizona-Nevada (Station No. 15).--Discharge and quality records are available for the 1968 report period except for the period November 1944 to September 1950. Quality data for this period are based on specific conductance with chemical analyses only at intermittent intervals.

Colorado River below Parker Dam, Arizona-California (Station No. 16).--Flow records for the report period are available for the Geological Survey gage below Parker Dam. Quality data were obtained from the Metropolitan Water District of Southern California which takes samples at the Lake Havasu intake pumping plant.

Colorado River at Imperial Dam, Arizona-California (Station No. 17).--Flow records are available for the report period. Records from January 1941 through September 1942 are from the station, Colorado River near Picacho, California. Records from October 1942 through September 1960 are based on the combined records of discharge obtained at gaging stations on Colorado River at Yuma, All American Canal near Imperial Dam, Gila Gravity Main Canal at Imperial Dam, Yuma Main Canal at Laguna Dam, and North Gila Valley Canal at Laguna Dam less that of Gila River near Dome, Arizona. Records after September 1960 are based on the combined daily discharge of Colorado River passing Imperial Dam and at gaging stations on All American Canal near Imperial Dam and Gila Gravity Main Canal at Imperial Dam.

Quality data for the period January 1941 to 1943 were obtained from the U.S. Department of Agriculture salinity laboratory at Riverside, California. Quality data since 1943 were obtained from Geological Survey records and are based on data for the Yuma Main Canal below the Colorado River Siphon.

3. Other Quality of Water Stations

In addition to the key stations discussed above, there are many more points at which water quality data are obtained. Most of these sampling stations are operated by the Geological Survey; however, some are operated by other Federal, State, and private agencies.

The type of data obtained and the purpose of the sampling vary with each station. Many of the stations provide data for the special studies described in Part IV, Basic Studies.

B. Methods of Chemical Analyses

Published quality of water records consist of a combination of stream discharges with chemical analyses of stream water samples collected at more or less regular intervals. The reliability of the records depend on the accuracy of the streamflow records, the frequency of collection and representativeness of the samples, the stability of the samples during the storage periods prior to making of the analyses, the completeness and accuracy of the individual analyses, and the manner in which the individual samples are combined before analysis to represent increments of stream discharge.

Most of the chemical analyses of water samples which provided the water quality data were made in the laboratories of the Geological Survey at Washington, D.C., Albuquerque, N. Mex., and Salt Lake City, Utah, using standard procedures by chemists specifically trained in water analysis. During the 28-year period considered there were numerous changes in laboratory techniques and procedures mostly due to introduction of new instrumental methods. New procedures were adopted only after careful investigation to insure results consistent with those obtained previously. Some of the quality of water records are based on analysis of samples by Bureau of Reclamation laboratories. Bureau of Reclamation results and methods have been checked by the Geological Survey to insure comparable records. Analyses by the Metropolitan Water District have been made by standardized procedures and appear to be comparable with analyses by the Geological Survey. It is probable that errors in the load computations due to errors in chemical analyses are less than those due to changes in the samples upon storage, inaccuracies in sampling, or inaccuracies in the determination of stream discharges.

C. Historic Mineral Quality

1. Total Dissolved-Solids Concentrations

Historic streamflow, total dissolved solids (salinity) concentrations, and salt-load data for the 17 key stations for the 1941-68 period of record are presented in Tables 1 to 17 with each table number corresponding to a station number.

To simplify tabulation, monthly values of flow and total dissolved solids loads were rounded to the nearest 1,000. This resulted in some differences between the recorded and the computed monthly concentrations when the flows were low, for example, below 1,000 acre-feet in the San Rafael and Duchesne Rivers. Similarly, minor differences from published data in monthly concentrations occur in isolated instances in the flow and quality tables for the other stations.

The addition of quality of water data for 1967 and 1968 produced little change in long-term averages in comparison to the 1941-66 period. Six of the stations show no change; at six, the concentration increased by 0.01 ton per acre-foot, and at three it increased by 0.02 ton per acre-foot. The average concentration for the Virgin River station for the period 1941-66 was 2.26 tons per acre-foot while the average concentration for the period 1941-68 was 2.29 tons per acre-foot, and the San Rafael River station concentration was increased from 2.2 to 2.3 tons per acre-foot.

EVALUATIONS OF EXISTING SALINITY CONDITIONS

The water quality at the Lees Ferry and the four other key stations on the Lower Colorado River has been affected by abnormal conditions during the 1959-68 period because of low runoff in 1959, 1960, and 1961 and the filling of Lake Powell during the period 1963-68. Figure 8 shows the historical weighted average salinity concentration for these five stations.

During the first year of storage in Lake Powell in 1963, the flow at Lees Ferry was reduced to 1,384,000 acre-feet with a salinity concentration of 1.27 tons per acre-foot. The average concentration for the 1941-68 period was 0.75 ton per acre-foot.

The salinity concentration increases between the Lees Ferry station and the Grand Canyon station primarily as a result of the additions of a large salt load from the Blue Springs located on the Little Colorado River. The 1963 flow at the Grand Canyon station was 1,384,000 acre-feet with a salinity concentration of 1.41 tons per acre-foot. The previous low flow was 4,186,000 acre-feet in 1934 with a salinity concentration of 1.32 tons per acre-foot. It is interesting to note that the 1963 concentration was only 0.09 tons per acre-foot higher than the 1934 concentration.

The Grand Canyon station has the longest water quality record on the Colorado River, 1926 to 1968. It is also of interest that the average salinity concentration for the period 1941-68 is only slightly higher than the average salinity concentration for the period 1926-40, 0.84 and 0.81 ton per acre-foot, respectively.

Generally the salinity concentration increases at each succeeding downstream station as a result of depletions by diversions, reservoir and stream evaporation, and consumptive use by irrigated crops and phreatophytes, and by salt loading by inflowing springs, streams, solution of salts from the streambeds and reservoir basins, and possibly by irrigation return flows. The flows of the Bill Williams River often dilute the flow of the Colorado River in Lake Havasu which sometimes results in a decrease in the salinity concentration from the Below Hoover Dam station to the Below Parker Dam station. Figure 8 shows the concentration changes between the five lower stations on the Colorado River. Note also that Lake Mead has a dampening and delaying effect, about 2 years, on the salinity concentrations at the downstream stations. This is especially noticeable for the high salinity concentrations of 1963 at the Lees Ferry and Grand Canyon stations.

2. Ionic Loads

In addition to the total dissolved-solids concentration of a water supply, the relative chemical composition may be of significance for some types of water use. Annual summary of ionic loads in tons-equivalent for the 1941-68 period have been included in this report to further depict quality conditions at six key stations: Green River at Green River, Utah;

WEIGHTED AVERAGE DISSOLVED SOLIDS CONCENTRATIONS, COLORADO RIVER BELOW LEES FERRY, ARIZONA

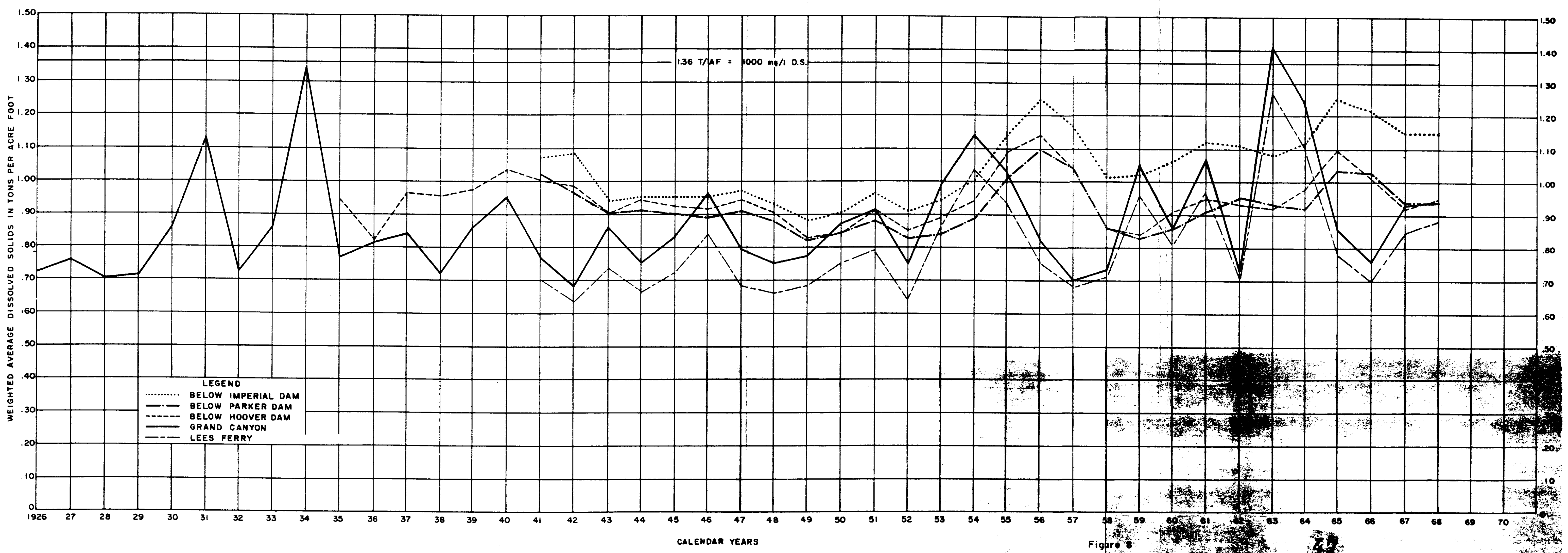


Figure 8

Colorado River near Cisco; San Juan River near Bluff; Colorado River at Lees Ferry; Colorado River below Hoover Dam; and Colorado River at Imperial Dam. Tables 20-25 give ionic loads for the six principal ions: calcium, magnesium, sodium, bicarbonates, sulfates, and chlorides. The specific conductance, sodium adsorption ratio, and total dissolved-solids concentrations are also shown. At each station the amount of potassium is negligible, and carbonates are generally not present.

D. Present Modified Condition

Present modified flow, as defined for this report, is the flow expected at any point with all upstream existing projects in operation for the full period of study. It was estimated at the various stations by assuming a recurrence of past water supply conditions and by deducting from the annual historical flows the depletions that would have resulted from the operation of all upstream projects constructed and in operation since that year. Besides adjusting for minor projects a correction was made for the historical operation and evaporation of the Colorado River Storage and Fontenelle Reservoirs in order to obtain unregulated flows at each station. Estimated present evaporation was then deducted to obtain present modified flows. Present evaporation from the Colorado River Storage Project and Fontenelle Reservoirs was estimated to be 649,000 acre-feet per year. This would include evaporation from Lake Powell of 533,000 acre-feet, Flaming Gorge 54,000 acre-feet, Navajo 30,000 acre-feet, Curecanti Reservoirs 15,000 acre-feet, and Fontenelle Reservoir 17,000 acre-feet. These are average figures which were chosen to represent present conditions rather than using the 1968 historical evaporation since a single year record could show an above-or-below normal condition. Present evaporation of the Lower Basin Reservoirs was assumed the same as historical since these reservoirs have been operating for a number of years.

Historical flows since 1941 have been affected by the transmountain diversions of the Colorado-Big Thompson Project, Duchesne Tunnel of Provo River Project, Roberts Tunnel of the City of Denver, and a number of small in-basin developments. More recently the Collbran, Paonia, Smith Fork, Silt, Florida, Hammond, and Emery County Projects and Vernal Unit of Central Utah Project have come into operation. Also, evaporation from the storage units--Glen Canyon, Flaming Gorge, Navajo, Curecanti and Fontenelle--is now in effect along with the Hayden Steamplant, Utah Construction Company steamplant, expansion of Hogback Indian lands, and the municipal and industrial uses in Wyoming. The depletions from these projects have been extended back to 1941, from the time they became operational, so that when new projects are imposed on the present modified condition the anticipated effects can be estimated. In the near future several projects now under construction will become operational. The addition of these new depletions results in slight increases in dissolved-solids concentrations under present modified conditions over the 1941-66 period.

EVALUATIONS OF EXISTING SALINITY CONDITIONS

Quality data for present modified conditions were computed by taking into consideration the weighted average of the concentrations of total dissolved solids for the various transmountain diversions. The change in dissolved solids resulting from the in-basin developments were computed on the basis of an assumed pickup of 2.0 tons of dissolved solids per acre of irrigated land and a depletion of 1.5 acre-feet of water per irrigated acre. Modified flows and quality for present conditions are shown in Table 18.

As in previous reports, present modified flows are used as a basis for developing the anticipated effect of the participating projects and other developments.

Following is a description of the storage units, now constructed, for which the evaporation losses were considered as depletions in the computation of present modified flows.

1. Glen Canyon Unit

The Glen Canyon Dam is located on the Colorado River in Arizona 4 miles south of the Utah-Arizona boundary and 15 miles upstream from Lees Ferry. The bulk of the reservoir lies in Utah. At a normal water surface elevation of 3,700 feet m.s.l., Lake Powell would extend 186 river miles up the Colorado River and 71 miles up from the mouth of the San Juan River. River mile 71 on the San Juan River is 133 river miles from Glen Canyon Dam. This 27,000,000-acre-foot reservoir will regulate the flow of the river for compact delivery purposes and for power generation and thus permit exchanges for upstream consumptive use of the water. Fish and wildlife conservation and recreation will also be of major significance. Storage commenced March 31, 1963, in Lake Powell.

2. Flaming Gorge Unit

This storage unit is located on the Green River in northeastern Utah and southwestern Wyoming. The primary purposes of the Flaming Gorge Unit are the regulation and storage of flood flows of the Green River and the generation of hydroelectric power. The reservoir has a storage capacity of 3,789,000 acre-feet. The stored water assists in complying with the terms of the Colorado River Compact and will, by exchange, furnish an irrigation supply for the participating projects in the Upper Basin States. In addition there will be benefits from fish and wildlife conservation and recreational facilities. Storage commenced November 1, 1962, at Flaming Gorge Reservoir, and from the records taken immediately below the dam it appears that the reservoir releases will be more uniform in quality than uncontrolled streamflow prior to reservoir construction.

3. Navajo Unit

The Navajo Dam and Reservoir are located on the San Juan River in northwestern New Mexico and southwestern Colorado. Total storage capacity of the reservoir is 1,709,000 acre-feet. This reservoir regulates the flow of the river for irrigation of the Hammond Project, the Navajo Indian Irrigation Project, and for other uses including by exchange potential uses above the reservoir and transmountain diversions to the San Juan-Chama Project. It also helps regulate the flows of the Colorado River at Lees Ferry. Other purposes include recreation, sediment control, fish and wildlife propagation, and flood control. Storage began July 1, 1962, and the effect on quality is recorded at the Archuleta station below Navajo Dam.

4. Curecanti Unit

Facilities of the Curecanti Unit, located in west-central Colorado, include the Blue Mesa, Morrow Point, and Crystal Dams, Reservoirs, and Powerplants. The primary purposes are regulation and storage of flood flows of the Gunnison River and generation of hydroelectric power. In addition benefits will be provided to recreation, fish and wildlife conservation, and irrigation. The reservoirs of the Curecanti Unit will help regulate the flows of the Colorado River at Lees Ferry. The storage capacity provided is 941,000 acre-feet at Blue Mesa, 117,000 acre-feet at Morrow Point, and 27,000 acre-feet at Crystal Reservoir with total reservoir evaporation losses estimated to average 15,000 acre-feet annually for all three units. Storage was initiated late in 1965 at the Blue Mesa Reservoir and on January 24, 1968, at the Morrow Point Reservoir. Construction has not yet been initiated on Crystal Dam, and it possibly should have been considered as a future development, but since the annual evaporation will amount to only about 300 acre-feet its effect is insignificant.

It is expected that operation of the Curecanti Unit on the Gunnison River will improve the quality of the Colorado River below Grand Junction during the late summer months.

5. Fontenelle Reservoir

Fontenelle Reservoir, located on the Green River above Green River, Wyoming, has a storage capacity of 345,000 acre-feet and regulates the flow in the Green River above Flaming Gorge Reservoir. It will be used to supply water to the Seedskadee Project lands after the project is completed.

PART VI. ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

In order to estimate the probable effect of the authorized or contemplated developments on the quality of water at certain points along the Colorado River, the developments have been generally listed in downstream order. By means of operation studies the estimated effects of each development can be shown at the pertinent stations. These results are tabulated in Table 18 for the new period of record used in this report. The table was computed on the basis of the 1941-68 average annual flow and total dissolved solids. An additional station, "Colorado River above Parker Dam," was included in the table only for purposes of clarification and maintaining continuity in computations. It should be noted that future concentrations were estimated without consideration to possible future control measures.

The anticipated future conditions evaluated in Table 18 would result from the construction of the Colorado River Basin Projects and non-Federal developments. Pickup of dissolved solids from newly irrigated lands has been computed for two assumed conditions, zero and 2 tons per acre pickup.

Following is a discussion of the various projects including a brief description of the physical conditions for each development authorized or contemplated for authorization and the anticipated effect of each on the quality of water at appropriate key stations. It should be recognized that the acreages and depletions as listed could change with change of plans on some of the contemplated projects. The figures presented below and in Table 19 are those which were current at the time of writing this report. In addition to the developments listed, a number of smaller private industrial developments either under construction or contemplated will result in certain depletions and will have some effect on water quality.

The effects of all upstream developments are carried on down to and including Imperial Dam.

A. Description of Projects

1. Above Green River near Green River, Wyoming

Seedskadee Project.--This multipurpose project is located adjacent to and will divert water from the Green River in southwestern Wyoming to irrigate about 58,000 acres of land. Municipal and industrial water, recreation, and fish and wildlife protection are other purposes of the project. A depletion of 145,000 acre-feet is anticipated when the project is fully developed. Fontenelle Dam and Powerplant are now complete, but irrigation of the project lands is awaiting results from the development farm now undergoing tests in the project area. The irrigation of 15,000 acres is in question until a determination has been made of the effect the mining of trona will have on land subsidence and irrigation development. The Seedskadee area has not been previously irrigated except for the land in the experimental development farm so it affords an opportunity to determine the effect irrigation has on water quality under the given soil and crop conditions. Present depletions amount to about 20,000 acre-feet including evaporation.

Industrial developments in southwestern Wyoming.--These include Westvaco, Green River and Rock Springs municipal and industrial, Stauffer, Allied Chemical, and other industries. They will consumptively use another 86,000 acre-feet above Green River, Wyoming, when fully developed. The only industry in Wyoming below the Green River near Green River, Wyoming, gage would be Utah Power & Light Company's steam-electric powerplant on Hams Fork which will consumptively use about 8,000 acre-feet.

The effect of Seedskadee irrigation project and industrial developments on water passing the Green River, Wyoming, gage would be an increase in concentration from 0.44 to 0.52 ton per acre-feet if no dissolved solids are leached from the land; and if 2 tons per acre are picked up, the concentration would increase to 0.63 ton per acre-foot.

2. Between Green River near Green River, Wyoming, and Green River near Greendale, Utah

Lyman Project.--This is a multipurpose project located in southwestern Wyoming. Project facilities consist of two dams and reservoirs. One will be located at the Meeks Cabin site on the Blacks Fork in Wyoming and will provide 33,000 acre-feet of storage capacity. The other will be located at the China Meadows site of the East Fork of Smith Fork in Utah and will provide 13,000 acre-feet of storage capacity. The project will have the primary purpose of providing supplemental water to 42,674 acres of existing farmland along with fish and wildlife and recreation benefits. Construction of Meeks Cabin Dam is nearing completion. This project will give an opportunity to study the effect on quality of adding supplemental water to lands already irrigated. The resulting new depletion will be 10,000 acre-feet.

Utah Power & Light Co. and Others.--This steam powerplant is at Kemmerer, and it is anticipated that depletions of this and other industrial developments will amount to about 8,000 acre-feet. (See description above under "Industrial developments in southwestern Wyoming.")

These projects, together with those above the Green River near Green River, Wyoming, gage, would cause an increase in concentration of the water at the Green River near Greendale gage of from 0.59 ton per acre-foot at present to 0.69 and 0.78 ton per acre-foot for zero ton per acre and 2 tons per acre pickup from newly irrigated land, respectively.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENT

3. Above Duchesne River near Randlett

Central Utah Project (Bonneville Unit).--The Bonneville Unit will include a transmountain diversion of water from the headwaters of the Duchesne River in the Uinta Basin portion of the Colorado River Basin to the Bonneville Basin. Related developments of local water sources will be made in both basins. The project will develop water for irrigation, municipal and industrial use, and power production. It will also provide benefits to recreation, fish and wildlife, flood control, water quality control, and area redevelopment.

The net depletion to the Green River will be 166,000 acre-feet of which 136,000 is exported to the Bonneville Basin and the balance is depleted in the Uinta Basin.

Central Utah Project (Upalco Unit).--The Upalco Unit will be located in Duchesne County near Roosevelt, Utah. The plan of development is primarily to provide supplemental irrigation water for Indian and non-Indian lands along Lake Fork River and to enhance recreation, fish, and wildlife while maintaining flood control. The mean annual stream depletion is estimated to be about 10,000 acre-feet.

Central Utah Project (Uintah Unit).--The Uintah Unit of Central Utah Project will provide a full supply to irrigate 7,800 acres of new lands and supplemental water to other lands on the south slope of the Uinta Mountains in the Uinta and Whiterocks Rivers drainage areas. The new annual depletion will be about 30,000 acre-feet.

The increase in concentration from present to future at this station would be from 0.96 ton per acre-foot to 1.73 and 1.81 tons per acre-foot for zero and 2 tons per acre pickup, respectively.

4. Between Green River near Greendale, Duchesne River near Randlett, and Green River at Green River, Utah

Four County, Colorado.--This non-Federal development, as proposed, would divert 40,000 acre-feet of water through the Continental Divide for use in Colorado. The water would be transported from the headwaters of the Yampa River through Rabbit Ears Pass to the North Platte Basin, from which basin an equivalent amount of water would be directed by exchange over Willow Creek Pass into the Colorado River drainage, thence by transbasin diversion to Lafayette, Erie, Broomfield, Brighton, Thornton, and Ft. Lupton.

Hayden Steamplant.--This plant in Colorado now using 4,000 acre-feet will eventually require 16,000 acre-feet of water.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

Cheyenne, Wyoming.--The city of Cheyenne diverts water from the Little Snake River to a tributary of the North Platte in exchange for water diverted from Douglas Creek for municipal use by the city of Cheyenne. This transmountain diversion is now using about 7,000 acre-feet and will ultimately deplete the Colorado River by an additional 24,000 acre-feet.

Savery-Pot Hook Project, Colorado-Wyoming.--This project is located in the Little Snake River Basin in southern Wyoming and northwestern Colorado. The authorized project plan calls for construction of an 18,600-acre-foot-capacity reservoir on Savery Creek and a 65,000-acre-foot-capacity reservoir on Slater Creek. This storage will make possible the irrigation of 17,920 acres of new land and will provide supplemental water for land presently irrigated. Plan modifications are being considered in the definite plan studies now underway. Depletion of the Little Snake River by the Savery-Pot Hook Project would amount to 27,000 acre-feet annually.

Central Utah Project (Jensen Unit).--This unit will be located along the Green River east of Vernal in Uintah County in Uinta Basin, Utah. Storage of water in Tyzack Reservoir on Brush Creek together with pumping from the Green River will supply 440 acres of new land and 3,640 acres of presently irrigated lands. Approximately 15,000 acre-feet of water is anticipated to be depleted by this project.

The estimated increase in concentration at the Green River, Utah, gage from present to future would be 0.64 ton per acre-foot to 0.73 and 0.78 ton per acre-foot for the zero and 2 tons per acre pickup, respectively. Projects affecting the flows would include all developments above the gage.

5. Above San Rafael River near Green River, Utah

With inclusion of the Emery County Project under present modified conditions, the only anticipated future effect would be steam-electric plants depleting about 5,000 acre-feet of water and replacing an estimated 4,000 acres of presently irrigated lands with industries.

6. Above Colorado River near Glenwood Springs

Denver, Englewood, Colorado Springs, and Pueblo, Colorado.--Expansion of municipal supplies for these four cities will eventually deplete the Colorado River by 216,000 acre-feet above present uses. These are transmountain diversions from the Blue, Fraser, and Eagle Rivers in the headwaters of the Colorado River. The diversions would vary according to runoff each year.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

M&I--Green Mountain.--Water stored in Green Mountain Reservoir will be released for industrial use in the vicinity of Kremmling, Colorado, and in Garfield County, Colorado. This depletion will ultimately be about 12,000 acre-feet.

Homestake Project, Colorado.--The Homestake Project in Colorado, under construction by the cities of Aurora and Colorado Springs, will divert an average of 49,000 acre-feet annually to the eastern slope from the headwaters of the Colorado River although the diversions will vary from year to year.

The above depletions would increase the dissolved-solids concentration at Glenwood Springs by 0.08 ton per acre-foot under either condition of pickup.

7. Between Colorado River near Glenwood Springs and Colorado River near Cameo

Independence Pass Expansion.--This development consists of enlarging and lining an existing collection system on the western slope in Colorado with provisions for winter operation. The water will be collected from the headwaters of Roaring Fork for transmountain diversion to the Arkansas River Basin. The new depletion to the Colorado River will be about 14,000 acre-feet annually with possible storage in enlarged Twin Lakes Reservoir.

Fryingpan-Arkansas Project.--Construction is still continuing on this project. This transmountain diversion project will transfer water from the headwaters of the Colorado to the Arkansas River. It is a multipurpose development to supply supplemental irrigation water, municipal water, and water for power production. In addition the project will also control floods originating above pueblo, retain sediment, preserve fish and wildlife, and provide recreation opportunities. The average annual depletion will be 70,000 acre-feet, including 1,000 acre-feet of evaporation from the Ruedi Reservoir on the west slope.

M&I--Ruedi Reservoir, Colorado.--Storage rights in Ruedi Reservoir would permit the use of 38,000 acre-feet for oil shale development along the Colorado River in Colorado. The water would be stored in Ruedi Reservoir on the Fryingpan River and then released through natural channels to the points of use in the oil shale areas. A possible future alternative use for all or part of this water would be for irrigation purposes.

West Divide Project, Colorado.--The West Divide Project will provide 115,600 acre-feet of water for irrigation and 77,500 acre-feet for municipal and industrial use. The irrigation water will supply nearly 19,000 acres of new land and a supplemental supply to 21,000 acres of land presently irrigated. The new depletion of Colorado River water will be 76,000 acre-feet annually. Project water will be obtained from a series of

Colorado River tributaries south of the river in west-central Colorado with most of the storage planned for the 105,000-acre-foot Placita Reservoir.

The above-described projects, together with those above the Glenwood Springs station, would increase the concentration at the Cameo Station from 0.60 ton per acre-foot under present modified conditions to 0.73 and 0.75 ton per acre-foot for future conditions assuming zero and 2 tons pickup per acre, respectively.

8. Above Gunnison River near Grand Junction

Fruitland Mesa Project, Colorado.--This project is located in western Colorado in Gunnison River Basin. A 48,235-acre-foot storage reservoir on Soap Creek and diversion from Crystal and Curecanti Creeks would provide water needed for 15,870 acres of newly irrigated land and 7,000 acres of land now irrigated. Project uses will increase Colorado River depletions by 28,000 acre-feet per year.

The project water for irrigation use has been determined by laboratory analysis to be of excellent quality. Likewise, most of the return flow considered as part of the project water supply will be diluted with higher quality direct flow.

Bostwick Park Project, Colorado.--This small project is located in Montrose and Gunnison Counties in west-central Colorado. Storage regulation will be provided by a 13,520-acre-foot reservoir on Cimarron Creek, a tributary of the Gunnison River. Only 1,610 acres of new land will be irrigated and the increased depletion to the Colorado River will be 4,000 acre-feet. Some additional water will be provided to land now irrigated. The water of Cimarron Creek has been determined by laboratory analysis to be of good quality for irrigation. The Bostwick Park Project is now under construction and is scheduled for completion in the latter part of 1970.

Dallas Creek Project, Colorado.--The Dallas Creek Project will develop water of the Uncompahgre River and tributaries for irrigation and municipal and industrial use. The project will provide water for 15,000 acres of new land and supplemental water for 8,700 acres of land presently irrigated. Depletion of the Colorado River will amount to 37,000 acre-feet annually.

The project water supplies will be suitable in quality for irrigation and for municipal and industrial uses as well.

At the Gunnison River near Grand Junction station the concentration would be increased by 0.04 ton per acre-foot with no pickup and 0.08 with 2 tons per acre pickup.

9. Between Colorado River near Cameo, Gunnison River near Grand Junction, and Colorado River near Cisco, Utah

Dolores Project, Colorado.--The Dolores Project will divert water from the Dolores River Basin to the San Juan drainage for the irrigation of 61,000 acres. Some 32,000 acres will be new land; the remaining 29,000 acres of land are now receiving a partial supply. This project will divert 140,000 acre-feet of water from the Dolores River of which 8,700 acre-feet will be depleted and the balance returned to the San Juan River.

Return flows from lands in the Montezuma Valley are presently used for irrigation of land in McElmo Canyon outside the project area. Analyses show these flows have relatively high concentrations of soluble salts. They are successfully used for irrigation, however, because of internal drainage characteristics of the soils. The salt concentration of these flows is not expected to increase with project development.

San Miguel Project, Colorado.--The San Miguel Project will regulate flows of the San Miguel River for irrigation, municipal and industrial use, recreation, flood control, and fish and wildlife conservation. The project will supply water to 26,000 acres of new land and 12,500 acres of land now receiving a partial supply. Depletion of the Colorado River will be about 85,000 acre-feet.

The Colorado River near Cisco gage is affected by all upstream developments on the Colorado, Gunnison, and Dolores Rivers and their tributaries. These transmountain diversions and in-basin projects increase the concentrations from 0.91 to 1.08 tons per acre-foot with no pickup and to 1.12 with 2 tons per acre pickup.

10. Above San Juan River near Archuleta

San Juan-Chama Project.--Construction is underway on this transmountain diversion project with delivery of water to the Rio Grande Basin expected to be initiated in 1971. The project will divert an average of 110,000 acre-feet annually from the headwaters of the San Juan River across the Continental Divide to the Rio Grande Basin. The effect of this depletion on the Colorado River will be that some dissolved solids will be transported out of the basin and less high quality water will be available downstream for dilution of lower quality water.

The water will be used in New Mexico for municipal and industrial developments and for irrigation.

Navajo Indian Irrigation Project.--Construction activities are underway on this project, but completion of construction and delivery of water are several years away. The direct diversion of 508,000 acre-feet of water annually from the Navajo Reservoir to 110,000 acres of lands south of the San Juan River is contemplated. None of these lands are presently irrigated and the effect of irrigation on the quality and quantity of return flow is difficult to predict.

There will be times under ultimate basin development when the San Juan Valley lands below Farmington, New Mexico, will be dependent largely upon return flows for their supply of irrigation water. There are very little data upon which to base estimates of the quality of the return flow. Miscellaneous records from the San Juan, Animas, and La Plata Rivers indicate some periods of low flow water of questionable quality, especially from La Plata River system where some of the lands are known to be of marine origin. Practically all of the lands in the Navajo Indian Irrigation Project which would contribute return flow at the Hogback, however, are of fresh water origin with low salinity and alkalinity as determined by soil borings. To ascertain the quality of return flow with any degree of certainty, additional field data will be necessary prior to completion of definite plan investigations. The estimated depletion is 250,000 acre-feet annually.

The effect of the San Juan-Chama and Navajo Indian Irrigation projects in the quality of water at this station would be small since the water is presently of very good quality and the station is located only a short distance below the Navajo Dam where there would be no return flows. The increase in concentration would be from 0.23 ton per acre-foot present to 0.24 ton per acre-foot for both zero and 2 tons per acre pickup.

11. Between San Juan River near Archuleta and San Juan River near Bluff

Animas-La Plata Project, Colorado-New Mexico.--The Animas-La Plata Project will develop flows of the Animas and La Plata River systems for irrigation, municipal and industrial use, recreation, and fish and wildlife conservation. The project will supply water to 46,500 acres of new land and 25,600 acres of presently irrigated land. The new land will include 17,200 acres of Indian land. The total new depletion will amount to nearly 146,000 acre-feet. Project features include four storage dams, lengthy canals, and several diversion dams.

Preliminary water quality studies indicate that irrigation will not present any particular quality problem, and the additional return flow at the state line may be somewhat improved over the present.

Expansion Hogback.--This direct diversion to Indian lands adjacent to the San Juan River will result in a new depletion of about 10,000 acre-feet annually. These lands, in the vicinity of Shiprock, New Mexico, have been developed in small blocks by the Bureau of Indian Affairs over a period of years with further expansion planned for the future. The seepage and return flows return direct to the San Juan River, but the quality of these flows has not been determined.

Utah Construction Company.--In northwestern New Mexico, a large steam-electric powerplant, which has been partially completed by Utah Construction Company for the Navajo Indian Tribe and the Arizona Power Authority, is now using 15,000 acre-feet out of an estimated 40,000 acre-feet when the plant is complete.

The San Juan River near Bluff gage would be affected by all developments on the San Juan River above the gage. Especially notable would be return flows from the Indian Irrigation Project. The result would be an increase from 0.63 to 0.91 and 1.25 tons per acre-foot, respectively, for the zero and 2 tons per acre pickup from new irrigated lands.

12. Between Green River at Green River, Utah, San Rafael River near Green River, Utah, Colorado River near Cisco, San Juan River near Bluff, and Colorado River

Resources, Incorporated, Utah.--Resources, Incorporated, proposed to construct a large powerplant in Utah near Lake Powell using coal from the Kaiparowits Plateau for fuel and water from Lake Powell for plant operation. The expected annual depletion to the Colorado River would be 102,000 acre-feet, based on the company's application to the State of Utah for that much water. The exact date of this depletion is not known at present.

M&I in Arizona.--The Upper Colorado River Compact allocated 50,000 acre-feet to Arizona from the Upper Colorado River system and of that amount about 15,000 acre-feet is presently being used.

The remaining 35,000 acre-feet will be used in that portion of Arizona within the Upper Basin and would be diverted above Lees Ferry with most of it being used by the Navajo Powerplant at Lake Powell.

The total depletions and salt pickup above Lees Ferry increase the concentration at the Lees Ferry gage from 0.84 to 1.01 tons per acre-foot with no pickup, and with 2 tons of pickup the concentration increases from 0.84 to 1.09 tons per acre-foot.

13. Above the Virgin River at Littlefield, Arizona

Dixie Project, Utah.--The recently authorized Dixie Project will, through construction of a multipurpose dam on the Virgin River, provide a full water supply to 6,900 acres of new land and a supplemental water supply to 10,000 acres of existing irrigated land. About 5,000 acre-feet of municipal and industrial water will be provided to the city of St. George. Cedar City, Utah, can also exercise an existing agreement to divert up to 8,000 acre-feet of water out of the basin from upper tributaries.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

A principal concern of the downstream users in Arizona and Nevada will be in regard to the effect of project operations on water quality and the amount of flood waters available for leaching purposes. In this regard the effect of the highly mineralized LaVerkin Springs, which enter the river above the proposed Virgin River Dam, is of considerable importance.

The estimated increased depletion of the Virgin River due to total project development will be 48,000 acre-feet per year. Disposal of the waters of the LaVerkin Springs would increase the estimated annual depletion by the quantity of water removed from the river system. The average annual flow of the Virgin River at Littlefield under present conditions based on January 1941 through December 1968 records is 151,000 acre-feet. Concentrations would increase from the present 2.29 to 3.34 and 3.48 tons per acre-foot under zero and 2 tons pickup, respectively.

14. Between the Colorado River at Lees Ferry, Virgin River at Littlefield, and Colorado River below Hoover Dam

Southern Nevada Water Project, Nevada.--The Southern Nevada Water Project, now under construction, will provide supplemental municipal and industrial water to the cities of Las Vegas, North Las Vegas, Henderson, and Boulder City and to Nellis Air Force Base. It will also provide water to the potential Eldorado Valley development.

In the ultimate stage of development of the project, the estimated total annual diversions from Lake Mead by the existing Boulder City and Basic Management, Inc., water systems will be 52,000 acre-feet. The estimated total annual diversions by the project will be 328,000 acre-feet, giving a total ultimate annual diversion from Lake Mead to the project area of 380,000 acre-feet.

The estimated net annual depletion due to the project and existing systems will total 262,000 acre-feet allowing for creditable return flows of 118,000 acre-feet. The diversions in 1968 from Lake Mead were 29,790 acre-feet by Basic Management, Inc., and the Las Vegas Valley Water District, and 3,230 acre-feet for Boulder City and the Lake Mead National Recreation Area, a total of 33,000 acre-feet. No creditable return flow from these diversions was listed in the "Compilation of Records in Accordance with Article V of the Decree of the Supreme Court of the United States in the Arizona v. California Dated March 9, 1964," for calendar year 1968. If we assume for purposes of computations in this report that unidentified return flows from the 33,000 acre-feet diverted in 1968 would be in about the same proportion to diversions as was assumed in the determination of depletions for the Southern Nevada Water Project, there would be a return flow of about 10,000 acre-feet. This would give a depletion for 1968 of about 22,000 acre-feet and the additional annual depletion with full development of the Southern Nevada Water Project would be 240,000 acre-feet.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

It has been assumed in this report that the Colorado River return flows from the Southern Nevada Water Project would carry as much salt as would be pumped from the river. It is possible that measures may be taken that would result in a reduction of salts returned to the river. Various proposals have been made for removing or reclaiming the return flow discharged into Las Vegas Wash in order to control pollution problems in the Las Vegas arm of Lake Mead. If any of these proposals are adopted, they will be evaluated in future progress reports.

A portion of the Southern Nevada Water Project allotment of 262,000 acre-feet will be used by the Southern California Edison Company by diverting 30,000 acre-feet annually from the Colorado River for thermal power production purposes at a site about 3 miles downstream from Davis Dam. Use of this water until July 1, 2006, by the Southern California Edison Company is in accordance with two contracts--one with the State of Nevada and the Southern California Edison Company and one with the Bureau of Reclamation and the State of Nevada. This depletion is included in the depletion anticipated for the Southern Nevada Water Project and would not cause an additional depletion.

The Southern Nevada Water Project, plus all developments above Lees Ferry and on the Virgin River, would affect the salinity at the Colorado River below Hoover Dam station. Salinity concentrations would increase from 1.03 tons per acre-foot at present to 1.29 and 1.38 tons per acre-foot for estimated future concentrations under conditions of zero and 2 tons per acre pickup.

15. Between Colorado River below Hoover Dam and Colorado River at Imperial Dam

Fort Mohave Indian Reservation.--The Fort Mohave Indian Reservation, located below Davis Dam, is allocated water by the Supreme Court Decree to irrigate 18,974 acres of land in Arizona, California, and Nevada with a maximum annual diversion from the Colorado River of 122,648 acre-feet. The consumptive use required for irrigation of these lands is estimated to be 4 acre-feet per acre, which would result in main-stream depletion of about 76,000 acre-feet annually. The Bureau of Indian Affairs reports that a major portion of this reservation is under development contract.

The consumptive use of 4 acre-feet per acre for irrigation of the Fort Mohave, Chemehuevi, and Colorado River Indian lands is based on the rate presented in Colorado River Basin Project hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, House of Representatives. This value is under study and may be subject to change in future reports.

Chemehuevi Indian Reservation.--The Chemehuevi Indian Reservation, located above Parker Dam, is allocated water by the Supreme Court Decree to irrigate 1,900 acres of land in California with a maximum annual diversion from the main stream of the Colorado River of 11,340 acre-feet. The consumptive use required for irrigation of these lands is estimated to be 4 acre-feet per acre, which would result in a main stream depletion of about 7,000 acre-feet annually. Full development of this reservation is expected by 1990.

Central Arizona Project.--The Colorado River Basin Project Act authorizes the Central Arizona Project for the purposes of furnishing irrigation and municipal water supplies to the water-deficient areas of Arizona and western New Mexico through direct diversion or exchange of water. This project will provide a supplemental water supply to lands now being irrigated. Water will be made available only to lands having a recent irrigation history. The Central Arizona Project must stand shortages up to its full allocation if there is insufficient main stream water to satisfy an annual consumptive use of 7,500,000 acre-feet allocated under the Supreme Court Decree of March 1964 to the States of Nevada, Arizona, and California. When shortages occur, diversions to the Central Arizona Project will be limited to assure California water users 4,400,000 acre-feet of main stream water. With present development, as reflected in the present modified flow listed in Table 18, there would be an average of 2,147,000 acre-feet available for diversion to the Central Arizona Project. With a small cutback of 25,000 acre-feet in California's historic diversion, there would be 2,172,000 acre-feet, which is all that could be diverted with a canal capacity of 3,000 c.f.s. California diversions would eventually be reduced to 4,400,000 acre-feet while the Central Arizona Project supply would gradually reduce to 433,000 acre-feet when all of the future depletions listed in Table 19 are made.

Contracts--Boulder Canyon Project.--Separate contracts have been signed with the City of Kingman, Arizona, the Lake Havasu Irrigation and Drainage District, and the Mohave Valley Irrigation and Drainage District for diversion, respectively, of 18,500 acre-feet, 14,500 acre-feet, and 51,000 acre-feet annually. Although some new lands may be developed for irrigation in the Mohave Valley Irrigation and Drainage District, other lands now irrigated will be taken out of production due to future municipal and industrial development. As a result, it is probable that the diversion under the contract with the Mohave Valley Irrigation and Drainage District would cause no appreciable increase over the present depletions from existing irrigation in the District and municipal and industrial development would result in an increased depletion of about 6,000 acre-feet per year. All of the diversions to the city of Kingman would be a depletion because of the distance of the city from the Colorado River. Diversion to Lake Havasu Irrigation and Drainage District would cause an increased depletion of about half of the diversion. It is estimated the maximum diversions allowed under the three contracts would cause an increased depletion of about 31,000 acre-feet per year.

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

Lower Colorado River Indian Reservation.--The Lower Colorado River Indian Reservation is located along the Colorado River just below Parker Dam, Arizona, with most of the land in Arizona and the remainder in California. The Supreme Court Decree allocated 717,148 acre-feet of diversions to the Colorado River Indian Reservation for irrigation of 107,588 acres of land. The consumptive use required for irrigation of these lands is estimated to be 4 acre-feet per acre, which would result in an annual main stream depletion of 430,352 acre-feet. The consumptive use in 1968 from irrigation of 46,748 acres is estimated to be 186,992 acre-feet. This leaves an additional depletion of about 243,000 acre-feet per year for future developments.

Lower Colorado River Channelization Project, Arizona-California.--Between Davis Dam and Parker Dam, the channelization work in the Mohave Valley Division was completed in 1960 to salvage an estimated 109,000 acre-feet of water per year. However, the permanence of 44,000 acre-feet of that salvage is dependent on future maintenance in the Topock Gorge Division. The work in the Topock Gorge Division would also salvage an additional 28,000 acre-feet per year.

Between Parker Dam and Imperial Dam, work in the Palo Verde Division to salvage 10,000 acre-feet of water per year has been completed and is considered to be reflected in the 1968 streamflow records. Work in the Cibola Division to salvage 36,000 acre-feet per year was completed in 1970 but is not considered to be reflected in the 1968 streamflow records. Work in the Parker and Imperial Divisions to salvage 39,000 acre-feet per year has not yet been started.

In summary, at the end of 1968 channelization work to salvage 119,000 acre-feet of water per year was complete, and work to salvage 103,000 acre-feet per year was either underway or planned.

It is estimated that an additional 100,000 acre-feet of water per year could be salvaged by phreatophyte eradication and control. The locations where work would be done have not been finally selected. For purposes of this study, locations of salvage developed for the Pacific Southwest Water Plan have been used. It indicated salvage of 88,000 acre-feet would be above Imperial Dam; of this amount, 59,000 acre-feet would be above Parker Dam and 29,000 acre-feet would be between Parker and Imperial Dams. The combined annual salvage above Parker Dam from the channelization and phreatophyte eradication and control programs would be 87,000 acre-feet. Between Parker and Imperial Dams, the salvage from the combined programs would be 104,000 acre-feet. The total salvage above Imperial Dam is 191,000 acre-feet.

In addition to developments above Hoover Dam, the Central Arizona Project, development of Indian lands on the Fort Mohave, Chemehuevi, and Colorado River Indian Reservations, a decrease in diversions through the

ANTICIPATED EFFECTS OF ADDITIONAL DEVELOPMENTS

Colorado River Aqueduct by the Metropolitan Water District, separate contracts to various water users, and increases to the water supply resulting from salvage by channelization and phreatophyte control of the Lower Colorado River will all contribute to changes in the salinity concentration at Imperial Dam.

Salinity concentrations at the Colorado River below Parker Dam station would increase from the present 1.01 tons per acre-foot to 1.27 and 1.37 tons per acre-foot for the zero and 2 tons per acre pickup conditions, while the concentration at Imperial Dam would increase from the present 1.18 tons per acre-foot to 1.57 and 1.70 tons per acre-foot for the zero and 2 tons per irrigated acre pickup conditions.

PART VII. EFFECTS OF SALINITY ON WATER USE

Water quality can be a limiting factor in the use of a water supply. Different water uses require different water qualities, and a supply may thus be acceptable for some uses but unsuitable for others. Most water uses have a range of quality within which a supply may be acceptable for that use. Use of water at the low quality end of this range may impose an economic, a social, and/or a political penalty on the water user in comparison to use of the water at a higher quality. The suitability of the quality of a water supply for use is thus a relative matter and must be evaluated with regard to specific uses and the social and economic aspects of such use.

A major objective of this report is to assess the suitability of Colorado River water for various beneficial uses. The following sections discuss the physical and economic effects of salinity on water uses in the Colorado River Basin. The effects of water quality on water uses as measured by parameters other than salinity are discussed in Part IX.

A. In-stream Use

The major in-stream uses of water in the Colorado River Basin include hydroelectric power production, propagation of fish and aquatic life, recreation (including water contact sports), and aesthetics. Within the range of salinity concentrations expected in the foreseeable future, salinity should have no significant effects on these uses.

B. Irrigation Use

A major portion of the basin water supply is consumptively used for irrigation. Any effects of water quality on this use are thus of major importance. Crops grown in the basin differ in sensitivity to a salt concentration in the soil root zone, with some crops tolerating significantly higher concentrations in the root zone than the more sensitive crops. Also, most crops require a lower salinity concentration in the root zone during the germinating and seedling stage than they do later in the growing cycle. Salinity concentrations in the root zone are affected by the salinity concentration of the irrigation water, the relationship of consumptive use to the water supplied to the crop by irrigation and rainfall, and the drainability of the soil. If, however, all other factors remain unchanged, the salinity concentration of the root zone will vary with the salinity concentration of the irrigation water. Thus an increase in the salinity concentration of the irrigation water will decrease the productivity of the crops if its tolerance limit of salinity concentration in the root zone is exceeded. Because of the many factors affecting the salinity concentration in the root zone, an exact irrigation water concentration that will damage a crop cannot be determined.

Damage to crops can be prevented by applying additional irrigation water to flush the salts from the soil. If natural drainage or an existing drainage system is inadequate to remove the additional water, it may be necessary to install additional drains. Without sufficient water for flushing the salts from the soils the grower has the choice of producing less per acre or of switching to a crop that is more salt tolerant. The more salt-tolerant crops, however, generally have a lower economic return than the salt-sensitive crops. Therefore, it is probable that, if the salinity concentration of the irrigation water becomes high enough to cause damage to crops, the grower will suffer a decrease in his economic return.

In the Upper Basin, salinity concentrations during the irrigation season are relatively low except in local areas. The impact of salinity on irrigation in the Upper Basin is thus minimal.

In the Lower Basin, present peak salinity concentrations are approaching critical levels for some salt-sensitive crops and, while suitable for irrigation of most crops, are believed to be high enough that in some cases decreases in crop yields could occur. Although Colorado River water is accepted for irrigation use, future increases in salinity may thus involve the incurring of a small but significant economic loss.

C. Industrial Use

Colorado River water has not been widely used for industrial purposes within the basin, but extensive use has been made of this water from transmountain diversions outside the basin. Since the quality of the water diverted from the Upper Basin is relatively high, only minimal pretreatment is required for most industrial uses. In the Lower Basin, the higher salinity levels in the diverted flows may require more extensive pretreatment for some types of industrial uses.

The quality of water required for industrial use varies widely and is dependent upon the purposes for which the water is utilized. Within any industrial plant, water may have several functions.

Cooling is the largest single use of industrial water supplied from the Colorado River, ranging from 57 percent to 80 percent. Because available water is limited, recirculatory cooling systems are the prevalent type. About 3,000 mg./l. is the maximum salinity concentration that can be used in a system unless it is constructed of corrosion-resistant material. Salt concentrations are held below this limit by blowdown (discharging a part of the cooling water to waste and replacing it with water having a lower salinity concentration). Usually the cooling water and boiler system water are treated to inhibit scale formation and corrosion. The amount of cooling water needed by a specific industry is proportional to the salinity concentration of the available water. The cost of treating both cooling and boiler water also varies proportionally with the salinity concentration.

Tables 20-25, showing yearly summaries of the ionic loads at six stations, can be used by industry to evaluate the water available to meet its needs.

D. Domestic Use

For domestic water use, it is desirable to have a safe, clear, potable, aesthetically pleasing water supply which meets the recommended limits of the Public Health Service Drinking Water Standards of 1962. High salinity levels affect the taste of drinking water and may affect the digestive system.in some people. Water hardness, which generally increases with increases in salinity concentrations, also requires more soap and laundry additives to achieve acceptable cleaning results. If the water becomes too hard, softening of the supply in large-scale municipal plants or in individual home units may be required. Sealing of water heaters and corrosion of pipes also accelerate with increased salinity or hardness levels.

Water quality in the Upper Basin will generally meet the Public Health Service standards with normal levels of treatment--settling, filtration, and disinfection. In some cases only disinfection is required. In contrast to the Upper Basin, the water supply at most points in the Lower Basin does not meet the Public Health Service recommended limits for total dissolved solids, exceeding the maximum acceptable limits at times. Mineralized water supplies with salinity concentrations in the range of those values observed in the Colorado River, however, are commonly accepted in the southwestern United States, with little detriment to the potability of the supply. The use of this mineralized supply imposes an increased treatment cost as hardness levels are high enough that water softening is provided for some of the supply in addition to normal treatment.

Softening of Colorado River water is extensive enough that small increases in hardness affect softening costs appreciably.

PART VIII. THE POTENTIAL FOR SALINITY CONTROL

The various legislative acts discussed in Part I authorize the Secretary of the Interior to study means of improving the quality of water in the Colorado River Basin and to develop comprehensive plans for achieving such water quality enhancement. A number of activities have been undertaken with the objectives of evaluating various salinity control aspects. Some of these activities were previously discussed. The following sections summarize the present knowledge of the potential for achieving basinwide control of salinity.

A. Technical Possibilities for Salinity Control

There are a number of salinity control measures which could be potentially useful for minimizing and controlling salinity in the Colorado River Basin. These measures, which may be divided into measures for increasing the water supply and measures for reducing the salt load, are listed in Table D .

Various factors such as economic feasibility, lack of research, and legal and institutional constraints limit the practicality of most measures. The most practical means of augmenting the basin water supply include importing water from other basins, importing demineralized sea water, and utilizing weather modification techniques to increase precipitation and runoff within the basin. Practical means of reducing salt loads include: impoundment and evaporation of point source discharges, diversion of runoff and streams around areas of salt pickup, improvement of irrigation and drainage practices and facilities, desalination of saline discharges from natural and man-made sources, and desalination of water supplies at points of use.

B. Feasibility of Salinity Control

Eight potential alternative salinity control programs incorporating a variety of control measures were formulated by the Federal Water Quality Administration to provide the basis for evaluating the costs and salinity control effects of a basinwide control program. These alternatives included three salt-load reduction programs, four flow augmentation programs, and one program to demineralize water supplies at the point of use.

The three salt-load reduction programs utilized control measures such as desalination or impoundment and evaporation of mineral spring discharges, irrigation return flows and saline tributary flows, diversions of streams and improvement of irrigation practices and facilities. The Federal Water Quality Administration estimated that the programs have a potential salt-load reduction of up to 3 million tons annually and possibly could reduce average salinity concentrations at Hoover Dam by about 200 to 300 mg./l.

Table D. Possibilities for Salinity Control

I. Measures for increasing water supply

  A. Water conservation measures
    1. Increased watershed runoff
    2. Phreatophyte control
    3. Optimized water utilization for irrigation
      a. Reduced consumptive use
      b. Improved irrigation efficiency

  B. Water augmentation measures
    1. Weather modification
    2. Water importation
      a. Fresh water sources
      b. Demineralized sea water

II. Measures for reducing salt loading

  A. Control of natural sources
    1. Natural discrete sources
      a. Evaporation of high saline discharges
      b. Injection into deep geological formations
      c. Desalination
      d. Suppression of discharge
      e. Reduction of recharge
    2. Natural diffuse sources
      a. Surface diversions
      b. Reduced ground water recharge
      c. Reduced sediment production

  B. Control of man-made sources
    1. Municipal and industrial sources
      a. Evaporation of high saline discharges
      b. Injection into deep geological formations
      c. Desalination
    2. Irrigation return flows
      a. Proper land selection
      b. Canal lining
      c. Improved irrigation efficiency
      d. Proper drainage
      e. Treatment or disposal of return flows

THE POTENTIAL FOR SALINITY CONTROL

The four flow augmentation programs evaluated were based on three potential sources of water: increased precipitation and runoff through weather modification, interbasin transfer of water, and importation of demineralized sea water. Since investigations of the potential feasibility of interbasin transfer of water into the Colorado River Basin are prohibited by law until after 1978, the evaluation of such programs was limited to the effects of flow augmentation on salinity concentrations and did not include an evaluation of the feasibility of interbasin transfer or of potential sources of surplus water. The volume of flow augmentation assumed to be provided by the programs evaluated ranged from 1.7 to 5.9 million acre-feet annually. Resulting reductions in average salinity concentrations at Hoover Dam ranged from 100 to 300 mg./l.

Desalination of water supplies diverted from the Lower Colorado River for use in Southern California was evaluated as an alternative to reducing salinity levels in the river system.

C. Salinity Control Investigations

Both the Bureau of Reclamation and the FWQA have participated in a number of basic studies directed toward the objectives of developing and demonstrating methods of minimizing salinity concentrations in the Colorado River system. In addition to the research efforts previously discussed in Section E, Part IV, several salinity control investigations have just been completed or are in progress. These investigations are discussed below.

1. Cooperative Salinity Control Reconnaissance Study

Early in FY 1968, the FWQA and the Bureau of Reclamation initiated a cooperative salinity control reconnaissance study in the Upper Basin to identify controllable sources of salinity, determine technically feasible control measures, and estimate their costs. The first year of this study was financed by a transfer of funds from FWQA to the Bureau, and the second year was financed by the Bureau. A shortage of funds forced discontinuance of the study during FY 1970. The results of the study to date will be presented in a report to be released at a later date.

Reconnaissance level preliminary plans were developed by the study for two salinity control projects and cost estimates prepared for a number of control methods. One preliminary plan developed was for the Paradox Salinity Control Project which would reduce the heavy pickup of salt by the Dolores River as it crosses a salt anticline in Paradox Valley in western Colorado. Control would be achieved by regulating peak flood flows and conveying the streamflow through a lined canal past a recharge area for a saline ground water system. Estimates of project costs and salinity control benefits were prepared which indicated this project may be economically feasible.

A preliminary plan was also prepared for a project to control the salt load from Crystal Geyser, an abandoned oil test well which periodically discharges highly mineralized water in much the same manner as a geyser. Control would be achieved by collecting the geyser discharge and pumping it to a lined impoundment for evaporation. Cost estimates for this project also indicated marginal economic feasibility. A project of this type may be potentially applicable to control of some of the more concentrated small mineral springs if suitable land area for an evaporation pond can be found and evaporation rates are high enough.

For control of irrigation return flows, the costs of impounding and evaporating the flows at two topographically different sites were estimated. The costs of deep well injection of relatively small quantities of the more concentrated return flows were also estimated. The feasibility of controlling irrigation return flows by evaporation or deep well injection would appear to be doubtful at this time on the basis of salinity control benefits alone.

The cost of lining canals and distribution systems in several existing irrigation projects as a salinity control measure was also investigated. The economic feasibility of this type of control measure was not evaluated, however, as the effectiveness of canal lining in reducing salt loads from irrigated areas has not been fully determined.

2. Grand Valley Salinity Control Demonstration Project

This project, located near Grand Junction, Colo., was initiated in FY 1969 under a FWQA demonstration grant. The objective of this project is to demonstrate the salinity control potential of lining irrigation canals and laterals. The Grand Valley is underlain by an aquifer containing highly saline ground water. Seepage from canals and laterals contributes to the recharge of this aquifer. This recharge displaces the saline ground water into the Colorado River, increasing its salt load. Reduction of such recharge by reducing seepage from conveyance systems is thus expected to reduce the salt load discharged to the river.

A major portion of the canals and some of the laterals serving a study area of about 4,600 acres were lined with concrete in 1969 and 1970. Most of the lining was accomplished by a corporation of local irrigation and drainage districts which direct the demonstration project. Colorado State University is conducting the data collection activities and evaluating the salinity control effects under contract from the corporation. A simulation model is being developed which will evaluate the effects of changes in irrigation efficiency on salt-load contributions as well as changes in seepage losses from the conveyance system. This model will allow the results of the demonstration project to be projected valley-wide upon completion of the study and form the basis for future salinity control activities in this location. Completion of the demonstration project, including all post-construction studies, is scheduled for mid-1972.

3. Other Related Investigations

A research project entitled, "Effect of Water Management on Quality of Ground Water and Surface Recharge in Las Vegas Valley," was initiated by Desert Research Institute in late 1969 under a FWQA research grant. This project will evaluate, among other things, the movement of salts in the ground water system and the exchange of salts between the ground water and surface waters of Las Vegas Wash. Research results will help define the optimum approach to control of this salt source. Completion of the research effort is scheduled for mid-1973.

A cooperative regional research effort, "Project W-107, Management of Salt Load in Irrigation Agriculture," was initiated in 1969 by seven western universities and the Agricultural Research Service's U.S. Salinity Laboratory. Work underway or planned covers a wide range of salinity management aspects and should provide data applicable to basin salinity problems.

D. Completed Salinity Control Projects

During the latter part of FY 1968, the FWQA made funds available and requested the Bureau of Reclamation to select a pilot project to test and demonstrate control methods for reducing salinity concentrations and salt loads in the Colorado River system. The plugging of two flowing wells, the Meeker and Piceance Creek wells near Meeker, Colo., was selected as the pilot demonstration project. The Bureau of Reclamation's contractor completed plugging the Meeker well on August 3, 1967, and the Piceance Creek well on August 9, 1968. Closing of the Meeker well reduced the sodium and chloride concentrations of the White River by over 50 and 75 percent, respectively, at the Geological Survey gage below Meeker. Plugging the Piceance Creek well decreased the sodium, bicarbonate, and chloride concentrations over 10 percent at the mouth of Piceance Creek, 13 miles downstream from the well. The salinity load of the White River and the Colorado River system was reduced by about 62,500 tons annually. This is about 19 percent of the average annual salinity load in the White River near Watson, Utah. Plugging the Meeker and Piceance Creek wells initially decreased the annual flow of the White River by about 2,380 acre-feet. It is the opinion of the Bureau's regional geologist that the flow formerly discharged from the wells will reappear through natural springs nearer the recharge area at an improved quality, and that plugging the wells will not cause a permanent decrease of the annual flow in the White River.

Costs for plugging the two wells totaled $40,000. It is estimated by the Federal Water Quality Administration that the present worth of total benefits which will accrue to Colorado River water users is approximately $7 million. Thus, this project demonstrated the economic feasibility of plugging similar flowing saline wells in addition to demonstrating significant local water quality improvement. The high benefit-cost ratio for this project would indicate that plugging wells discharging considerably lesser amounts of salt would be economically feasible.

Another flowing well near Rock Springs, Wyo., which contributed approximately 5,000 tons of salt annually, was plugged in November 1968 under the direction of the Wyoming State Engineer. The effects of eliminating this salt source have not been evaluated.

In late 1969 the Utah Oil and Gas Commission plugged seven abandoned oil test wells near Moab, Utah. This action eliminated a salt load of approximately 33,000 tons per year which was formerly contributed by two of the wells. The other five wells were not flowing. Costs of plugging the wells totaled about $35,000.

It is estimated that plugging the five flowing wells in Colorado, Wyoming, and Utah will reduce the average annual salt load passing Hoover Dam by 100,000 tons or 0.93 percent. This salt load reduction would reduce average salinity concentrations by about 6 mg./l. under present conditions. Although this change in salinity concentrations is small with respect to present salinity levels, the resulting economic benefits are significant. These annual benefits are estimated to range from $400,000 in 1970 to $1 million in the year 2010 and have a present worth of more than $10 million. Thus, a modest but significant start has been made toward reducing the economic impact of rising salinity concentrations.

PART IX. OTHER WATER QUALITY ASPECTS

Although salinity is considered to be the most serious water quality problem in the Colorado River Basin, there are a number of other water quality problems of varying degrees of significance which warrant discussion. The following sections discuss the most significant sources of water quality degradation and the effects of such degradations on water uses as measured by various parameters.

A. Source of Water Quality Degradation

1. Municipal Wastes

Municipal wastes are described herein as those liquid-carried wastes of domestic and service industry origin. Within the Colorado River Basin the majority of the discharges from waste water treatment plants enter the river system and are the primary sources of bacteriological and organic pollution. Most of the municipal waste sources in the basin receive secondary treatment plus disinfection which is the minimum degree of treatment required by the Basin States.

Compliance schedules have been established for municipalities whose waste discharges are not meeting the water quality standards set by the States. At the present time, pollution from municipal waste sources is confined to those reaches of stream immediately downstream of the waste effluent, and measures are being taken or have been planned for the control or abatement of pollution from these sources.

2. Industrial Wastes

Industrial wastes are defined as those spent process waters, cooling waters, wash waters, and other waste waters associated with industrial operations. The pollutants derived from industrial wastes other than salinity are toxic materials, oils and grease, floating materials, radioactivity, oxygen-demanding substances, heat, color-, taste-, and odor-producing substances, and bacteria.

The pollution problems associated with the discharge of industrial wastes in the Colorado River system have been generally confined to local reaches of stream. An exception occurs, however, with the discharge of uranium mill effluents because of the persistent nature of the radioactivity in these effluents. Two enforcement conferences were called by the FWQA (formerly the Public Health Service, Division of Water Supply and Pollution Control) in the Animas River and the Colorado River Basins in an attempt to find solutions to the problems associated with uranium mill discharges. The majority of the uranium mills in the Colorado River

Basin have been closed but there still exists the potential for water pollution from the remaining mill tailings piles.

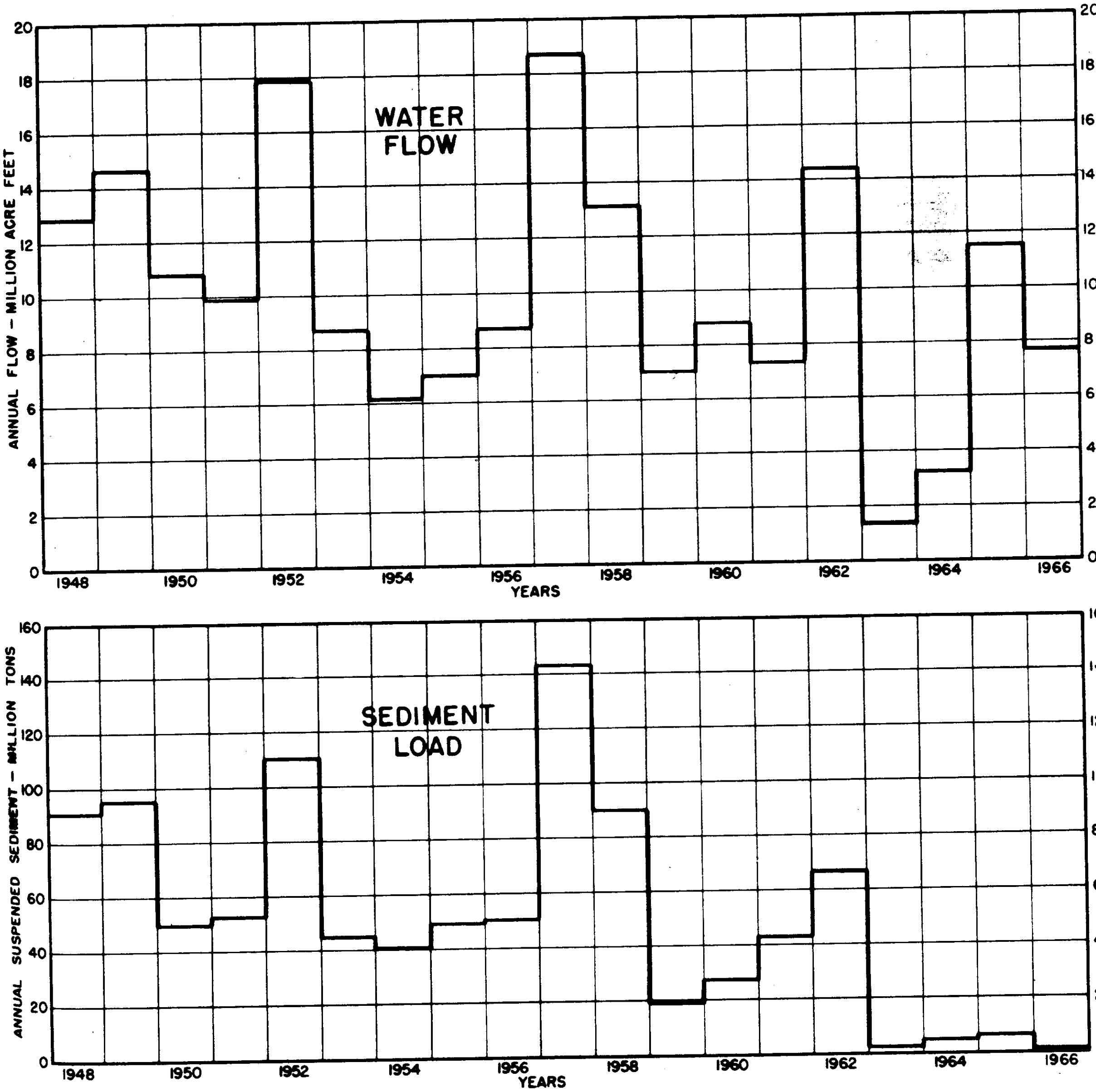
With the establishment of Water Quality Standards on interstate streams and compliance schedules for the implementation of these standards, the pollution from industrial waste sources in the basin has been or is being abated or controlled.

3. Sediment

Prior to construction of the storage units of the Colorado River Storage Project, most of the larger tributaries and the main stem of the Colorado River carried large loads of sediment, particularly in their middle and lower reaches.

For example, in 1957 the suspended sediment load of the Colorado River at Lees Ferry, Ariz., gaging station was recorded at 143 million tons. This sediment was detrimental to water diverters for consumptive use as well as to high-type fishery and other recreational uses. The construction of Fontenelle, Flaming Gorge, Curecanti Unit, Navajo, and Glen Canyon Dams has produced dramatic changes in the sediment load transported by these streams. For example, the relationship between the water and sediment flows at Lees Ferry during the 1948-66 period is illustrated in Figure 9 . In 1959 the cofferdam utilized in the construction of Glen Canyon Dam was finished and diversions began through the tunnels. Sediment was deposited behind the cofferdam in 1959 and 1960 at a sufficient rate to gradually fill the cofferdam lake with the result that by 1962 the annual sediment load at Lees Ferry had increased to 67 million tons. This load dropped to 2.2 million tons in calendar year 1963 with the closure of Glen Canyon Dam and initial storage in Lake Powell. Lake Powell and other Colorado River Storage Project reservoirs are now effectively trapping and storing almost all of the sediment originating in the Upper Colorado River Basin. Lake Powell traps approximately 80 percent of the sediment that normally would flow into Lake Mead. By storing the sediment in the Colorado River Storage Project reservoirs, the streams immediately below the dam have been changed to relatively clear trout water fisheries as well as desirable boating and recreational areas.

Suspended sediment records have been maintained at key locations to measure the changes taking place. Some of these stations are shown in Tables 39 to 44 and include Green River near Jensen, Utah; Green River at Green River, Utah; Colorado River near Cisco, Utah; San Juan River near Bluff, Utah; Colorado River at Lees Ferry, Ariz., and Colorado River near Grand Canyon, Ariz. Because the sediment load was essentially eliminated by the Glen Canyon Dam, sediment measurements at Lees Ferry were discontinued in September 1966.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER
AT LEES FERRY
SEDIMENT & WATER FLOW

Fig. 9

OTHER WATER QUALITY ASPECTS

4. Agricultural Wastes

Neglecting salinity pollution, pesticides, and fertilizers are the primary water pollutants associated with agriculture in the Colorado River Basin.

The chlorinated hydrocarbon group, e.g., DDT and Toxaphene, are the most persistent pesticides and are of primary concern because of their long-range impact. The organic phosphate compounds do not persist in the environment for the period the chlorinated hydrocarbons do, but they are more toxic to fish and humans. Data have been collected showing that pesticides are present in sufficient quantities at certain locations in the Lower Colorado River to be harmful to fish and aquatic life. The use of these compounds in areas above public water supply intakes requires that adequate precautions be taken to preclude entry into the river system.

Nitrogen and phosphorus fertilizers are the most commonly used in the basin. Studies conducted in other areas of the United States show a relationship between the concentrations of nutrients from agricultural lands and water quality problems caused by excessive fertilization of aquatic plants. The 1966 water quality study by the FWQA indicated that significant quantities of phosphorus were contributed from irrigated agriculture along the Lower Colorado River. Within the Colorado River Basin the animal waste pollution is minimal because outside surface water has been prevented from entering the feedlots either by directing the drainage away from the operation or by locating the facility in a favorable topographic position. Feedlot wastes, moreover, do not generally accumulate within the basin since facilities are set up to distribute the wastes onto adjacent farmland.

5. Mine Drainage

During 1966 to 1968 approximately 75 locations were sampled to determine the heavy-metal concentrations contributed by mine drainages, tailing piles, and natural sources within the Colorado River Basin. The streams with degraded reaches are listed in Table E which also shows the major sources and effects of the pollution. Many of these streams have heavy-metal concentrations in excess of PHS Drinking Water Standards and destroy aquatic life in about 120 miles of stream channel.

The Federal Water Pollution Control Act, as amended, authorizes the Secretary of the Interior to enter into agreements with any state or interstate agency "to demonstrate methods for the elimination or control, within all or part of a watershed, of acid or other mine water pollution resulting from active or abandoned mines." Efforts are currently underway to initiate an agreement under the provisions of this act to evaluate the effectiveness of several mine drainage control methods in the southwestern portion of the State of Colorado.

OTHER WATER QUALITY ASPECTS

Table E. Mine Drainage Sources and Effects, Colorado River Basin

Stream	Area of investigation	Major sources	Effects
Blue River Tenmile Creek	Headwaters to mouth at Frisco, Colo.	Wilfrey Mine; pump failure at Amax tailings ponds.	Some areas devoid of aquatic life due to high heavy-metals concentrations
Eagle River	Homestake Creek near Redcliff to Minturn, Colo.	Mineral spring near Belden, Colo.; former seepage from old tailings pile; New Jersey Zinc Corp. decant.	Aesthetics; destruction of biological productivity; high heavy-metals concentration; predominantly zinc.
Gunnison River Lake Fork	Headwaters to Lake City, Colo.	Golden Fleece Mine.	Aesthetics in northwest portion of Lake San Cristobal.
Uncompahgre River	Headwaters through Dexter Creek, upstream of Ouray, Colo.	Red Mountain Creek; via Genessee, Rouville, and Joker Tunnels, and Red Mountain adit; natural sources.	Aesthetics; low pH; high heavy-metals and mineral concentration; devoid of aquatic life.
Dolores River	Mouth of Coal Creek to Dolores-Montezuma County line.	St. Louis and Blaine Tunnels; Silver Swan adit; and others.	Aesthetics; minimal effect due to neutralization of mine drainage by natural river alkalinity.
San Miguel River	Upstream of confluence with South Fork.	Iron Springs; Penn Tunnel; other mine drains; natural sources.	Aesthetics; high heavy-metals concentration; minor effects on biological productivity.
San Juan River Animas River	Headwaters through Mineral Creek south of Silverton, Colo.	Cement Creek, north Mineral Creek via Bagley, American, and Koehler Tunnel; other adits, mills, and mine drains, natural sources.	Aesthetics; high heavy-metals concentration, particularly zinc; many areas devoid of aquatic organisms.
La Plata River	Headwater to Hesperus, Colo.	Natural sources.	Minimal effects.
Mancos River	Headwaters to confluence of Middle and East Forks.	Natural mineral seep.	Some destruction of aquatic life, particularly fish.

OTHER WATER QUALITY ASPECTS

B. Water Quality Parameters Other Than Salinity and Sediment

1. Dissolved Oxygen

The dissolved-oxygen concentration is a measure of the water capacity to support life and assimilate organic wastes. The records show that the dissolved-oxygen concentrations in the Colorado River Basin are generally above established standards. However, a marked reduction in the concentration can be found during the summer months below some municipal and industrial discharges and in some streams with very low flows. A 1966 investigation indicated that there might be a wide diurnal variation in the oxygen concentrations in some reaches because of the large amount of algae in the streams with oxygen saturation being reached during a sunlit day and a minimal concentration occurring at night when oxygen is used by the plants.

2. Temperature

The Colorado River Basin water temperatures vary widely, reaching the highest levels during the summer months when they vary from near freezing in the high mountains to above 90° F. in the lower reaches. Warmer temperatures may increase the rate of growth and the decomposition of organic matter and of chemical reaction, resulting in bad odors and tastes, and also decrease the dissolved oxygen concentration available to sustain a fishery.

Changes in water temperature in the basin result primarily from natural climatic conditions. The large reservoirs, however, may affect the stream temperatures for a considerable distance below the reservoir. Temperature records indicate that Flaming Gorge Reservoir has little or no effect on winter temperatures but cools the summer temperatures of the Green River up to 5° F. at the Green River, Utah, station. Navajo reservoir appears to have no effect on the temperatures of the San Juan River at the near Bluff station. Lake Powell appears to warm the winter temperatures of the Colorado River at the Grand Canyon station by up to 10° F. and cool the summer temperatures by about the same amount.

Thermal springs, waste-water discharges, and irrigation return flows may increase the temperatures in the receiving water, but the added heat is usually dissipated in a relatively short distance from the source. Flow depletions and changes in stream channel characteristics may also increase the effects of natural climatic conditions causing cooler or warmer water temperatures.

Temperature increases due to municipal and industrial waste discharges have been minimal; however, the construction of thermal powerplants in the basin with a return of the cooling water to the streams or reservoirs presents a potential for temperature increases. Any thermal discharge coupled with flow depletion could have a significant effect on water temperatures.

OTHER WATER QUALITY ASPECTS

Tables 26 through 38 contain the temperature records of 13 stations.

3. pH

The pH of the waters in the Colorado River Basin usually range from about 7 to 8 pH units with the exception of those streams receiving acid mine drainage. In this latter case the pH is lowered to levels which preclude the establishment of aquatic life and the use of the river for a fishery and other purposes.

4. Heavy Metals

Various heavy metals such as copper, lead, zinc, iron, manganese, arsenic, and cyanide are found in the waters of the basin. These vary from trace amounts to potentially hazardous levels. The presence of these heavy metals is generally contributed by drainage from active and inactive mining operations.

Iron and manganese concentrations frequently exceed the Public Health Drinking Water Standards in many basin streams. This is particularly evident in the upper reaches of the Colorado and San Juan Rivers and their tributaries. A 1966 water quality survey showed that heavy metal concentrations have a marked effect on the aquatic life. Toxicity of these metals to aquatic life is dependent not only on the toxicity of a single metal but also the synergistic effects of two or more metals. Certain reaches of stream are completely devoid of bottom organisms and fish because of these toxic effects.

5. Toxic Materials

In addition to the toxic effects of heavy metal concentrations, toxic materials are also contributed to the stream through industrial and agricultural operations. Limited long-term monitoring at four surveillance stations located on the Colorado River has detected the pesticides DDD, DDE, DDT, dieldrin, and endrin. There are, however, no data available for pesticides in other streams of the basin. A comprehensive evaluation of the effects of pesticides upon water quality cannot be made at this time because of the lack of water quality data and incomplete knowledge of the physiological and other effects of pesticides in human, wildlife, fish, and other biological forms. The mere presence of a pesticide in water does not necessarily indicate serious pollution. In recent years, however, several fish and bird mortalities, attributed to residual pesticides, have occurred downstream of and in irrigation drains along the Lower Colorado River.

6. Nutrients

Nutrients, primarily nitrogen and phosphorus, are believed to be the most conducive to the growth of algae. The sources of these nutrients are runoff from agricultural lands, municipal and industrial waste waters, and natural runoff. Phosphorus is normally found in only limited quantities in unpolluted water. Sufficient nitrogen is generally available naturally in basin waters to stimulate algae growth.

Quiescent reservoir waters are more susceptible to excessive plant growths than are rapidly flowing streams. Excessive growth of aquatic plants are present in the Las Vegas Bay (a highly used recreational area on Lake Mead) as a result of large nutrient inputs derived primarily from municipal and industrial effluents from the metropolitan Las Vegas area. The extensive algae growth has affected the use of the lake as a public water supply.

The nutrient concentrations in other lakes in the basin have reached levels which can support excessive algae growths. An excessive algae growth has been cited as the probable reason for a fish kill which occurred in the Flaming Gorge Reservoir in late 1963.

In the lower reaches of the Colorado River excessive aquatic plant growths have been associated with fertilization by nutrients discharged to irrigation return canals. A small increase in the nutrient levels in the river has been attributed to heavy recreational activities along the river below Davis Dam.

7. Bacteria

The coliform group of bacteria is used as an indicator of pollution. This group is made up of bacteria of diverse origin including that found in the intestinal tract of humans and other warmblooded animals as well as in the soil and on vegetation. High coliform counts in waters indicate the probable presence of pathogenic organisms where bacterial contamination from sewage or animal wastes appears likely.

In recent years analytical procedures have been developed whereby coliform bacteria of fecal origin can be identified. Fecal coliform tests measure bacteria from both man and animal. All the states of the basin have set standards for fecal coliform as the bacterial indicator of pollution.

High bacterial counts were observed at many locations in the Colorado River Basin during the 1966 water quality study. A number of these resulted from raw sewage discharges into a stream. In some cases, however, it was because of poor disinfection of the municipal waste water treatment plant effluents. The raw sewage discharges which were observed during the 1966 survey have been or are scheduled to be corrected by the addition of ponding treatment.

Bacteriological pollution has also been observed in popular recreation areas. For example, the fecal coliform densities in Lake Mead have been observed at densities higher than the standards set for body contact recreation (100/100 ml.).

Bacteriological pollution has an effect on most of the uses cited earlier. In those cases where it exceeds the criteria set for body contact recreation, it results in the closure of swimming areas. With high coliform counts, the use of water as a public water supply is impaired.

8. Radioactivity

An assessment of the radioactivity in the basin waters should also consider strontium 90 (Sr-90) radionuclides associated with atmospheric fallout in addition to radionuclides associated with industrial activities. Strontium 90, like the radionuclide Ra-226, is damaging to human bone cells. The effects of Ra-226 and Sr-90 are additive.

Radioactive pollution from industrial waste water effluents, i.e., uranium mills, was, prior to 1960, the major source of radioactive pollution in the basin. The majority of the mills have been closed down but a significant portion of the increase of radioactivity originates from the abandoned tailings piles. In combination with other radionuclides (e.g., Sr-90) the waters of the Colorado River system are now approaching or exceeding the recommended limits for radioactivity.

Radioactivity does impair the water for beneficial use when concentrations exceed certain limits. For example, the Public Health Drinking Water Standards set a mandatory limit of 3.0 picocuries Ra-226 and 10 picocuries/liter Sr-90. Moreover, the combination of these two radionuclides should conform to the following relationship: $\frac{\text{Sr-90}}{10} + \frac{\text{Ra-226}}{3} \leq 1.0$.

PART X. CONCLUSIONS

These studies indicate an overall increase in the concentration of total dissolved solids at the various points on the Colorado River and its tributaries under the conditions described. The quality of water will still be acceptable for present and most projected uses although some quality control measures are desirable in order to keep the future concentrations within usable limits.

Salinity is introduced into the Colorado River system from various sources but the natural source contributes the major portion of total dissolved solids. The addition of large storage units throughout the entire basin has dampened out the longtime and annual fluctuations in water quality.

The dampening influence on water quality fluctuations by many reservoirs in the basin will make it possible to more accurately forecast the quality of water delivery to the many projects and points of diversion in the basin.

The tributaries with exceptionally high dissolved-solids content have minor effect on the dissolved-solids concentration of the Colorado River as the volume of water and total tonnage of dissolved material represent only a very small portion of the total.

The special studies of irrigation projects that have been undertaken and their effect on the chemical quality of water permit these preliminary conclusions:

1. The early years of irrigation are generally the most detrimental to downstream water quality. This is primarily due to an abundance of soluble salts not previously exposed to a large amount of water.

2. Firm determinations cannot be made during the early years of development regarding the ultimate effect of irrigation. The primary factors in establishing equilibrium are the availability of soluble salts in the soils, the capacity of the ground water reservoirs, and the uniformity of irrigation practice in the area in question.

3. Each irrigated area has a different effect on quality depending upon properties of the soils and substrata in the drainage area, number of years the land has been irrigated, number of times return flow is reused, nature of the aquifers, rainfall, amount of dilution caused by surface wastes, temperature, storage reservoirs, vegetation, and types of return flow channels.

CONCLUSIONS

4. Future studies should consider other aspects of water quality effects, such as ion exchange, selective precipitation of salts, and changes in chemical composition (hardness, concentrations of specific constituents, etc.) on the river systems.

Programs to alleviate salt contributions to the river system are now underway in local areas.

Pollution to the Colorado River Basin other than salinity have not been a major problem in the past and with careful surveillance and control measures may not become a major problem in the future.

References Cited

Iorns, W. V., Hembree, C. H., and Oakland, G. L., 1965, Water Resources of the Upper Colorado River Basin--Technical Report: U.S. Geological Survey Professional Paper 441, 370 pages.

Table I

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Green River, Wyoming

Units – 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	22	0.73	16
	Feb.	19	.74	14
	Mar.	45	.69	31
	Apr.	95	.54	51
	May	174	.52	90
	June	342	.34	116
1941	July	137	.37	51
	Aug.	81	.46	37
	Sept.	48	.54	26
	Oct.	67	.60	40
	Nov.	53	.64	34
	Dec.	26	.81	21
	Total	1,109	.48	527
	Jan.	24	.79	19
	Feb.	23	.83	19
	Mar.	43	.70	30
	Apr.	200	.41	82
	May	151	.50	75
	June	337	.34	114
1942	July	205	.32	66
	Aug.	58	.52	30
	Sept.	32	.62	20
	Oct.	29	.76	22
	Nov.	26	.81	21
	Dec.	26	.77	20
	Total	1,154	.45	518
	Jan.	28	.78	22
	Feb.	29	.76	22
	Mar.	59	.63	37
	Apr.	200	.41	82
	May	237	.39	92
	June	476	.29	138
1943	July	359	.25	90
	Aug.	121	.39	47
	Sept.	50	.54	27
	Oct.	48	.67	32
	Nov.	43	.67	29
	Dec.	30	.77	23
	Total	1,680	.38	641
	Jan.	25	.80	20
	Feb.	25	.80	20
	Mar.	31	.77	24
	Apr.	267	.37	99
	May	155	.46	71
	June	351	.33	116
1944	July	230	.30	69
	Aug.	60	.50	30
	Sept.	31	.65	20
	Oct.	38	.71	27
	Nov.	31	.74	23
	Dec.	21	.81	17
	Total	1,265	.42	536
	Jan.	24	.79	19
	Feb.	27	.74	20
	Mar.	41	.68	28
	Apr.	78	.58	45
	May	111	.52	58
	June	245	.38	93
1945	July	284	.28	80
	Aug.	125	.39	49
	Sept.	76	.45	34
	Oct.	64	.62	40
	Nov.	42	.69	29
	Dec.	33	.73	24
	Total	1,150	.45	519
	Jan.	32	.75	24
	Feb.	26	.77	20
	Mar.	65	.62	40
	Apr.	131	.48	63
	May	212	.41	87
	June	320	.34	109
1946	July	153	.35	54
	Aug.	74	.47	35
	Sept.	52	.52	27
	Oct.	58	.64	37
	Nov.	51	.67	34
	Dec.	51	.67	34
	Total	1,225	.46	564
	Jan.	26	0.81	21
	Feb.	30	.73	22
	Mar.	141	.47	66
	Apr.	75	.57	43
	May	368	.33	121
	June	501	.29	145
1947	July	327	.26	85
	Aug.	199	.32	64
	Sept.	81	.44	36
	Oct.	75	.59	44
	Nov.	59	.63	37
	Dec.	44	.68	30
	Total	1,926	.37	714
	Jan.	38	.71	27
	Feb.	33	.73	24
	Mar.	64	.62	40
	Apr.	95	.54	51
	May	187	.43	80
	June	396	.31	123
1948	July	121	.39	47
	Aug.	56	.52	29
	Sept.	32	.62	20
	Oct.	36	.72	26
	Nov.	29	.76	22
	Dec.	26	.81	21
	Total	1,113	.46	510
	Jan.	27	.78	21
	Feb.	24	.79	19
	Mar.	45	.69	31
	Apr.	104	.52	54
	May	211	.41	86
	June	372	.32	119
1949	July	179	.36	64
	Aug.	65	.48	31
	Sept.	38	.58	22
	Oct.	52	.65	34
	Nov.	54	.65	35
	Dec.	34	.74	25
	Total	1,205	.45	541
	Jan.	29	.79	23
	Feb.	33	.73	24
	Mar.	102	.53	54
	Apr.	251	.38	95
	May	270	.37	100
	June	582	.34	198
1950	July	427	.23	98
	Aug.	140	.37	52
	Sept.	76	.45	34
	Oct.	66	.61	40
	Nov.	71	.59	42
	Dec.	49	.65	32
	Total	2,096	.38	792
	Jan.	34	.74	25
	Feb.	47	.66	31
	Mar.	70	.59	41
	Apr.	154	.45	69
	May	317	.35	111
	June	528	.28	148
1951	July	349	.25	87
	Aug.	208	.28	58
	Sept.	91	.43	39
	Oct.	81	.53	43
	Nov.	50	.68	34
	Dec.	43	.70	30
	Total	1,972	.36	716
	Jan.	41	.63	26
	Feb.	42	.62	26
	Mar.	52	.63	33
	Apr.	190	.52	99
	May	348	.32	111
	June	399	.27	108
1952	July	171	.33	56
	Aug.	99	.38	38
	Sept.	57	.51	29
	Oct.	42	.64	27
	Nov.	28	.82	23
	Dec.	27	.78	21
	Total	1,496	.40	597
	Jan.	32	0.69	22
	Feb.	33	.70	23
	Mar.	44	.68	30
	Apr.	77	.58	45
	May	74	.57	42
	June	381	.28	107
1953	July	206	.29	60
	Aug.	104	.39	41
	Sept.	39	.56	22
	Oct.	34	.74	25
	Nov.	36	.75	27
	Dec.	24	.88	21
	Total	1,084	.43	465
	Jan.	26	.81	21
	Feb.	27	.74	20
	Mar.	48	.67	32
	Apr.	88	.55	48
	May	282	.28	79
	June	232	.30	70
1954	July	250	.25	62
	Aug.	86	.40	34
	Sept.	47	.55	26
	Oct.	40	.68	27
	Nov.	39	.69	27
	Dec.	18	.89	16
	Total	1,183	.39	462
	Jan.	20	.80	16
	Feb.	20	.80	16
	Mar.	33	.76	25
	Apr.	74	.59	44
	May	127	.39	50
	June	245	.27	66
1955	July	116	.36	42
	Aug.	68	.41	28
	Sept.	35	.57	20
	Oct.	33	.70	23
	Nov.	28	.79	22
	Dec.	39	.74	29
	Total	838	.45	381
	Jan.	42	.69	29
	Feb.	29	.66	19
	Mar.	91	.56	51
	Apr.	158	.45	71
	May	310	.37	115
	June	555	.25	139
1956	July	197	.31	61
	Aug.	98	.38	37
	Sept.	41	.56	23
	Oct.	39	.59	23
	Nov.	35	.69	24
	Dec.	26	.77	20
	Total	1,621	.38	612
	Jan.	22	.77	17
	Feb.	37	.70	26
	Mar.	57	.68	39
	Apr.	60	.62	37
	May	176	.46	81
	June	476	.27	129
1957	July	380	.25	95
	Aug.	117	.35	41
	Sept.	68	.47	32
	Oct.	66	.55	36
	Nov.	48	.67	32
	Dec.	41	.71	29
	Total	1,548	.38	594
	Jan.	33	.76	25
	Feb.	47	.66	31
	Mar.	51	.63	32
	Apr.	99	.56	55
	May	291	.31	90
	June	266	.31	82
1958	July	76	.45	34
	Aug.	51	.53	27
	Sept.	36	.64	23
	Oct.	33	.79	26
	Nov.	32	.78	25
	Dec.	31	.74	23
	Total	1,046	.45	473

To obtain mg/l multiply T/AF by 735

Table I

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Green River, Wyoming

Units – 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
1959	Jan.	24	0.71	17
	Feb.	25	.72	18
	Mar.	49	.65	32
	Apr.	73	.64	47
	May	79	.51	40
	June	322	.26	84
	July	140	.34	48
	Aug.	79	.40	32
	Sept.	42	.55	23
	Oct.	51	.57	29
	Nov.	42	.60	25
	Dec.	27	.74	20
	Total	953	.44	415
1960	Jan.	27	.74	20
	Feb.	23	.78	18
	Mar.	75	.53	40
	Apr.	84	.49	41
	May	66	.48	32
	June	173	.30	52
	July	68	.43	29
	Aug.	38	.45	17
	Sept.	28	.54	15
	Oct.	42	.57	24
	Nov.	47	.49	23
	Dec.	27	.69	19
	Total	698	.47	330
1961	Jan.	20	.60	12
	Feb.	19	.58	11
	Mar.	30	.57	17
	Apr.	50	.60	30
	May	60	.43	26
	June	162	.27	44
	July	47	.43	20
	Aug.	35	.43	15
	Sept.	39	.46	18
	Oct.	41	.51	21
	Nov.	29	.52	15
	Dec.	27	.52	14
	Total	559	.43	243
1962	Jan.	32	.47	15
	Feb.	48	.48	23
	Mar.	77	.51	38
	Apr.	203	.43	87
	May	256	.36	92
	June	355	.27	96
	July	250	.27	68
	Aug.	94	.37	35
	Sept.	38	.58	22
	Oct.	38	.63	24
	Nov.	35	.66	23
	Dec.	25	.88	22
	Total	1,451	.38	545
1963	Jan.	18	.72	13
	Feb.	18	.72	13
	Mar.	42	.67	28
	Apr.	51	.63	32
	May	100	.45	45
	June	337	.26	88
	July	143	.32	46
	Aug.	76	.47	36
	Sept.	77	.43	33
	Oct.	58	.50	29
	Nov.	52	.60	31
	Dec.	30	.60	18
	Total	1,002	.41	412
1964	Jan.	23	.56	13
	Feb.	22	.59	13
	Mar.	29	.59	17
	Apr.	68	.56	38
	May	138	.32	44
	June	323	.38	123
	July	335	.26	87
	Aug.	87	.39	34
	Sept.	37	.65	24
	Oct.	24	.92	22
	Nov.	25	.88	22
	Dec.	25	.84	21
	Total	1,136	.40	458
1965	Jan.	28	0.79	22
	Feb.	30	.70	21
	Mar.	38	.74	28
	Apr.	44	.86	38
	May	94	.60	56
	June	429	.38	163
	July	466	.30	140
	Aug.	184	.36	66
	Sept.	461	.41	189
	Oct.	86	.73	63
	Nov.	75	.65	49
	Dec.	29	.90	26
	Total	1,964	.44	861
1966	Jan.	37	.76	28
	Feb.	35	.77	27
	Mar.	88	.72	63
	Apr.	138	.50	69
	May	160	.39	62
	June	171	.31	53
	July	91	.43	39
	Aug.	56	.52	29
	Sept.	45	.60	27
	Oct.	35	.77	27
	Nov.	30	.83	25
	Dec.	25	.96	24
	Total	911	.52	473
1967	Jan.	19	1.01	19
	Feb.	19	1.04	20
	Mar.	33	.87	29
	Apr.	129	.54	70
	May	138	.48	66
	June	456	.28	128
	July	448	.25	112
	Aug.	88	.39	34
	Sept.	65	.50	32
	Oct.	62	.56	35
	Nov.	49	.64	31
	Dec.	17	1.07	18
	Total	1,523	.39	594
1968	Jan.	17	1.03	18
	Feb.	16	1.03	16
	Mar.	33	.86	28
	Apr.	31	.93	29
	May	56	.68	38
	June	271	.40	108
	July	88	.41	36
	Aug.	136	.40	54
	Sept.	126	.37	47
	Oct.	117	.44	51
	Nov.	54	.58	31
	Dec.	30	.85	26
	Total	975	.49	482
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735

Table I
Colorado River Basin
Flow and Quality of Water Data
Green River near Green River, Wyoming
(Annual Summary)

Units — 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	1,109	0.48	349	527
1942	1,154	.45	330	518
1943	1,680	.38	280	641
1944	1,265	.42	311	536
1945	1,150	.45	332	519
1946	1,225	.46	338	564
1947	1,926	.37	272	714
1948	1,113	.46	337	510
1949	1,205	.45	330	541
1950	2,096	.38	278	792
1951	1,972	.36	267	716
1952	1,496	.40	293	597
1953	1,084	.43	315	465
1954	1,183	.39	287	462
1955	838	.45	334	381
1956	1,621	.38	277	612
1957	1,548	.38	282	594
1958	1,046	.45	332	473
1959	953	.44	320	415
1960	698	.47	347	330
1961	559	.43	319	243
1962	1,451	.38	276	545
1963	1,002	.41	302	412
1964	1,136	.40	296	458
1965	1,964	.44	322	861
1966	911	.52	382	473
1967	1,523	.39	287	594
1968	975	.49	363	482
Total	35,883			14,975
Average	1,282	.42	307	535

Sampled quality record May 1951 to December 1968; remainder by correlation.
Measured flow record January 1941 to September 1945; and April 1951 to December 1968; remainder by correlation.

Table 2

Colorado River Basin

Historical Flow and Quality of Water Data

Green River near Greendale, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	27	0.93	25
	Feb.	25	1.16	29
	Mar.	72	.94	68
	Apr.	131	.56	74
	May	276	.58	160
	June	441	.40	175
-1941	July	171	.55	94
	Aug.	110	.73	80
	Sept.	67	.78	52
	Oct.	94	.97	91
	Nov.	71	.93	66
	Dec.	36	1.19	43
	Total	1,521	.63	957
	Jan.	30	1.00	30
	Feb.	31	1.00	31
	Mar.	69	1.07	74
	Apr.	261	.65	170
	May	235	.76	180
	June	434	.44	193
-1942	July	239	.40	97
	Aug.	73	.57	42
	Sept.	40	.72	29
	Oct.	36	1.00	36
	Nov.	35	1.17	41
	Dec.	34	1.06	36
	Total	1,517	.63	959
	Jan.	33	1.09	36
	Feb.	37	.97	36
	Mar.	96	.74	71
	Apr.	262	.48	125
	May	338	.38	130
	June	552	.33	182
-1943	July	393	.29	115
	Aug.	163	.47	76
	Sept.	64	.56	36
	Oct.	60	.72	43
	Nov.	54	.83	45
	Dec.	37	.89	33
	Total	2,089	.44	928
	Jan.	30	.93	28
	Feb.	32	1.00	32
	Mar.	48	1.48	71
	Apr.	345	.55	190
	May	245	.58	142
	June	469	.37	174
-1944	July	278	.39	109
	Aug.	76	.49	37
	Sept.	36	.61	22
	Oct.	47	.83	39
	Nov.	39	.92	36
	Dec.	27	.85	23
	Total	1,672	.54	903
	Jan.	29	.97	28
	Feb.	34	.94	32
	Mar.	65	.88	57
	Apr.	113	.70	79
	May	176	.60	105
	June	310	.46	144
-1945	July	325	.37	120
	Aug.	174	.47	82
	Sept.	103	.43	44
	Oct.	74	.74	55
	Nov.	52	.88	46
	Dec.	42	.81	34
	Total	1,497	.55	826
	Jan.	39	.90	35
	Feb.	33	.85	28
	Mar.	88	.67	59
	Apr.	237	.48	115
	May	298	.44	130
	June	354	.37	133
-1946	July	162	.40	64
	Aug.	81	.57	46
	Sept.	62	.60	37
	Oct.	68	.76	52
	Nov.	63	.82	52
	Dec.	62	.77	48
	Total	1,547	.52	799
	Jan.	32	0.81	26
	Feb.	37	.89	33
	Mar.	195	.62	120
	Apr.	136	.62	84
	May	521	.40	210
	June	628	.36	225
-1947	July	372	.35	131
	Aug.	218	.45	99
	Sept.	91	.53	48
	Oct.	90	.70	63
	Nov.	71	.77	55
	Dec.	56	.87	49
	Total	2,447	.47	1,143
	Jan.	47	.91	43
	Feb.	40	.88	35
	Mar.	102	.79	81
	Apr.	157	.70	110
	May	336	.38	126
	June	454	.36	162
-1948	July	126	.50	63
	Aug.	59	.56	33
	Sept.	33	.76	25
	Oct.	39	.77	30
	Nov.	34	.85	29
	Dec.	31	1.00	31
	Total	1,458	.53	768
	Jan.	31	.90	28
	Feb.	29	.93	27
	Mar.	73	.89	65
	Apr.	152	.69	105
	May	310	.53	165
	June	493	.47	230
-1949	July	205	.52	106
	Aug.	72	.61	44
	Sept.	42	.74	31
	Oct.	70	.93	65
	Nov.	66	.97	64
	Dec.	40	.97	39
	Total	1,583	.61	969
	Jan.	36	1.19	43
	Feb.	45	.95	43
	Mar.	150	.61	92
	Apr.	323	.46	150
	May	416	.46	190
	June	741	.37	275
-1950	July	458	.34	154
	Aug.	153	.51	78
	Sept.	86	.62	53
	Oct.	76	.72	55
	Nov.	80	.75	60
	Dec.	61	.84	51
	Total	2,625	.47	1,244
	Jan.	45	.80	36
	Feb.	61	.82	50
	Mar.	93	.78	73
	Apr.	212	.47	100
	May	395	.45	177
	June	626	.36	225
-1951	July	366	.36	132
	Aug.	228	.44	101
	Sept.	98	.56	55
	Oct.	99	.71	70
	Nov.	57	.91	52
	Dec.	54	.87	47
	Total	2,334	.48	1,118
	Jan.	49	.82	40
	Feb.	52	.81	42
	Mar.	63	.75	47
	Apr.	318	.62	198
	May	600	.39	235
	June	554	.36	201
-1952	July	205	.56	114
	Aug.	121	.60	72
	Sept.	67	.67	45
	Oct.	49	.86	42
	Nov.	37	1.11	41
	Dec.	34	1.18	40
	Total	2,149	.52	1,117
	Jan.	48	0.81	39
	Feb.	48	.85	41
	Mar.	73	.86	63
	Apr.	96	.76	73
	May	110	.64	70
	June	452	.39	175
-1953	July	198	.39	77
	Aug.	105	.54	57
	Sept.	43	.63	27
	Oct.	35	.89	31
	Nov.	42	.98	41
	Dec.	32	.97	31
	Total	1,282	.57	725
	Jan.	28	1.11	31
	Feb.	39	.87	34
	Mar.	62	.81	50
	Apr.	101	.65	66
	May	302	.31	94
	June	223	.36	81
-1954	July	265	.28	73
	Aug.	81	.43	35
	Sept.	45	.69	31
	Oct.	42	.95	40
	Nov.	41	.85	35
	Dec.	20	1.05	21
	Total	1,249	.47	591
	Jan.	24	.75	18
	Feb.	24	.71	17
	Mar.	44	1.11	49
	Apr.	106	.64	68
	May	168	.52	88
	June	288	.33	95
-1955	July	130	.38	49
	Aug.	80	.52	42
	Sept.	38	.58	22
	Oct.	38	.68	26
	Nov.	36	.75	27
	Dec.	45	.82	37
	Total	1,021	.53	538
	Jan.	50	.86	43
	Feb.	38	.76	29
	Mar.	150	.47	70
	Apr.	203	.43	87
	May	368	.39	144
	June	615	.29	178
-1956	July	207	.33	69
	Aug.	104	.42	44
	Sept.	48	.44	21
	Oct.	46	.74	34
	Nov.	39	.82	32
	Dec.	26	.88	23
	Total	1,894	.41	774
	Jan.	28	.86	24
	Feb.	43	.79	34
	Mar.	66	.91	60
	Apr.	86	.67	58
	May	275	.54	148
	June	685	.37	251
-1957	July	433	.36	155
	Aug.	142	.57	81
	Sept.	82	.58	48
	Oct.	77	.69	53
	Nov.	57	1.00	57
	Dec.	46	.91	42
	Total	2,020	.50	1,011
	Jan.	43	.77	33
	Feb.	55	.80	44
	Mar.	66	.71	47
	Apr.	134	.67	90
	May	386	.39	151
	June	335	.38	127
-1958	July	87	.50	44
	Aug.	57	.56	32
	Sept.	39	.69	27
	Oct.	36	.72	26
	Nov.	34	.70	24
	Dec.	38	.84	32
	Total	1,310	.52	677

To obtain mg/l multiply T/AF by 735.

Table 2

Colorado River Basin

Historical Flow and Qualitv of Water Data

Green River near Greendale, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
1959	Jan.	29	0.86	25
	Feb.	32	.91	29
	Mar.	65	.92	60
	Apr.	98	.71	70
	May	115	.57	66
	June	368	.36	132
	July	176	.51	90
	Aug.	93	.47	44
	Sept.	58	.79	46
	Oct.	68	.72	49
	Nov.	51	.76	39
	Dec.	37	.99	37
	Total	1,190	.58	687
1960	Jan.	26	.81	21
	Feb.	29	.86	25
	Mar.	149	.70	104
	Apr.	140	.55	77
	May	127	.58	74
	June	216	.43	93
	July	78	.49	38
	Aug.	43	.47	20
	Sept.	35	.56	20
	Oct.	49	.65	32
	Nov.	54	.67	36
	Dec.	27	.84	23
	Total	973	.58	563
1961	Jan.	27	.73	20
	Feb.	27	.77	21
	Mar.	64	.86	55
	Apr.	76	.69	52
	May	79	.59	47
	June	192	.32	61
	July	56	.44	25
	Aug.	43	.58	25
	Sept.	55	.68	37
	Oct.	64	.70	45
	Nov.	54	.70	38
	Dec.	44	.78	34
	Total	781	.59	460
1962	Jan.	43	.65	28
	Feb.	83	.81	67
	Mar.	150	.84	126
	Apr.	374	.55	206
	May	394	.41	162
	June	456	.40	182
	July	297	.39	116
	Aug.	109	.48	52
	Sept.	44	.64	28
	Oct.	48	.79	38
	Nov.	5	.80	4
	Dec.	16	.94	15
	Total	2,019	.51	1,024
1963	Jan.	23	.91	21
	Feb.	26	.92	24
	Mar.	6	.83	5
	Apr.	8	.87	7
	May	8	.87	7
	June	7	.86	6
	July	6	.83	5
	Aug.	6	.83	5
	Sept.	7	.86	6
	Oct.	8	.87	7
	Nov.	19	.58	11
	Dec.	46	.63	29
	Total	170	.78	133
1964	Jan.	58	.57	33
	Feb.	56	.57	32
	Mar.	37	.59	22
	Apr.	35	.63	22
	May	91	.64	58
	June	86	.60	52
	July	150	.61	92
	Aug.	122	.61	74
	Sept.	131	.61	80
	Oct.	159	.64	102
	Nov.	139	.60	83
	Dec.	194	.62	120
	Total	1,258	.61	770
1965	Jan.	216	0.63	136
	Feb.	213	.70	149
	Mar.	233	1.05	245
	Apr.	204	.83	169
	May	66	.80	53
	June	86	.86	74
	July	29	.86	25
	Aug.	31	.87	27
	Sept.	44	.89	39
	Oct.	79	.79	62
	Nov.	120	.73	88
	Dec.	116	.65	75
	Total	1,437	.79	1,142
1966	Jan.	72	.64	46
	Feb.	72	.65	47
	Mar.	71	.76	54
	Apr.	130	.79	103
	May	83	.78	65
	June	95	.76	72
	July	104	.75	78
	Aug.	118	.72	85
	Sept.	124	.73	91
	Oct.	124	.77	95
	Nov.	85	.81	69
	Dec.	111	.76	84
	Total	1,189	.75	889
1967	Jan.	142	.74	105
	Feb.	96	.75	72
	Mar.	67	.77	52
	Apr.	85	.81	69
	May	122	.83	101
	June	195	.83	162
	July	171	.85	145
	Aug.	188	.86	162
	Sept.	180	.82	148
	Oct.	188	.87	164
	Nov.	173	.85	147
	Dec.	197	.72	142
	Total	1804	.81	1469
1968	Jan.	187	.70	131
	Feb.	123	.72	89
	Mar.	76	.83	63
	Apr.	96	.88	84
	May	119	.81	96
	June	97	.77	75
	July	198	.75	148
	Aug.	200	.75	150
	Sept.	181	.75	136
	Oct.	140	.73	102
	Nov.	137	.68	93
	Dec.	137	.68	93
	Total	1691	.75	1260
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 2

Colorado River Basin
Flow and Quality of Water Data
Green River near Greendale, Utah
(Annual Summary)

Units — 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	1,521	0.63	462	957
1942	1,517	.63	465	959
1943	2,089	.44	327	928
1944	1,672	.54	397	903
1945	1,497	.55	406	826
1946	1,547	.52	380	799
1947	2,447	.47	343	1,143
1948	1,458	.53	387	768
1949	1,583	.61	450	969
1950	2,625	.47	348	1,244
1951	2,334	.48	352	1,118
1952	2,149	.52	382	1,117
1953	1,282	.57	416	725
1954	1,249	.47	348	591
1955	1,021	.53	387	538
1956	1,894	.41	300	774
1957	2,020	.50	368	1,011
1958	1,310	.52	380	677
1959	1,190	.58	424	687
1960	973	.58	425	563
1961	781	.59	433	460
1962	2,019	.51	373	1,024
1963	170	.78	575	133
1964	1,258	.61	450	770
1965	1,437	.79	584	1,142
1966	1,189	.75	550	889
1967	1,804	.81	599	1,469
1968	1,691	.75	548	1,260
Total	43,727			24,444
Average	1,562	.56	411	873

Sampled quality record October 1956 to December 1968 (fragmentary); remainder by correlation.
Measured flow record entire period.

Table 3

Colorado River Basin

Historical Flow and Quality of Water Data

Duchesne River near Randlett, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	25	1.12	28
	Feb.	24	1.29	31
	Mar.	21	1.71	36
	Apr.	20	1.50	30
	May	155	.50	78
	June	232	.38	88
1941	July	35	1.11	39
	Aug.	18	1.50	27
	Sept.	15	1.60	24
	Oct.	54	.93	50
	Nov.	51	.90	46
	Dec.	44	1.04	46
	Total	694	.75	523
	Jan.	40	.90	36
	Feb.	39	1.00	39
	Mar.	39	1.23	48
	Apr.	50	.90	45
	May	83	.72	60
	June	171	.46	79
1942	July	23	1.43	33
	Aug.	8	2.12	17
	Sept.	5	2.40	12
	Oct.	18	1.50	27
	Nov.	22	1.41	31
	Dec.	28	1.28	36
	Total	526	.88	463
	Jan.	26	1.12	29
	Feb.	29	1.17	34
	Mar.	29	1.51	44
	Apr.	43	1.00	43
	May	100	.64	64
	June	103	.62	64
1943	July	28	1.21	34
	Aug.	23	1.39	32
	Sept.	8	2.00	16
	Oct.	22	1.40	31
	Nov.	24	1.29	31
	Dec.	25	1.28	32
	Total	460	.99	454
	Jan.	23	1.08	25
	Feb.	26	1.31	34
	Mar.	43	1.20	52
	Apr.	48	.94	45
	May	128	.57	73
	June	255	.37	94
1944	July	82	.72	59
	Aug.	8	2.00	16
	Sept.	7	2.14	15
	Oct.	24	1.37	33
	Nov.	26	1.30	34
	Dec.	28	1.32	37
	Total	698	.74	517
	Jan.	30	1.00	30
	Feb.	27	1.18	32
	Mar.	32	1.40	45
	Apr.	24	1.29	31
	May	59	.86	51
	June	91	.67	61
1945	July	30	1.23	37
	Aug.	31	1.19	37
	Sept.	12	1.75	21
	Oct.	21	1.38	29
	Nov.	26	1.27	33
	Dec.	24	1.37	33
	Total	407	1.08	440
	Jan.	23	1.13	26
	Feb.	21	1.38	29
	Mar.	29	1.41	41
	Apr.	40	1.00	40
	May	70	.78	55
	June	47	.95	45
1946	July	5	2.60	13
	Aug.	6	2.33	14
	Sept.	4	2.75	11
	Oct.	17	1.53	26
	Nov.	32	1.22	39
	Dec.	30	1.20	36
	Total	324	1.16	375
	Jan.	26	1.07	28
	Feb.	36	1.08	39
	Mar.	36	1.27	46
	Apr.	23	1.30	30
	May	143	.53	76
	June	158	.49	78
1947	July	33	1.18	39
	Aug.	25	1.28	32
	Sept.	12	1.75	21
	Oct.	17	1.65	28
	Nov.	29	1.21	35
	Dec.	31	1.19	37
	Total	569	.86	489
	Jan.	29	1.00	29
	Feb.	26	1.31	34
	Mar.	40	1.20	48
	Apr.	31	1.23	38
	May	70	.79	55
	June	51	.92	47
1948	July	3	3.00	9
	Aug.	2	3.50	7
	Sept.	1	3.00	3
	Oct.	5	2.40	12
	Nov.	14	1.71	24
	Dec.	26	1.27	33
	Total	298	1.14	339
	Jan.	24	1.08	26
	Feb.	23	1.30	30
	Mar.	44	1.20	53
	Apr.	46	.98	45
	May	127	.56	71
	June	230	.39	90
1949	July	50	.94	47
	Aug.	7	2.14	15
	Sept.	8	2.13	17
	Oct.	25	1.28	32
	Nov.	29	1.21	35
	Dec.	28	1.29	36
	Total	641	.78	497
	Jan.	31	1.00	31
	Feb.	26	1.23	32
	Mar.	40	1.30	52
	Apr.	44	1.00	44
	May	97	.67	65
	June	193	.43	83
1950	July	45	1.00	45
	Aug.	9	2.00	18
	Sept.	13	1.77	23
	Oct.	16	1.56	25
	Nov.	27	1.26	34
	Dec.	33	1.36	45
	Total	574	.87	497
	Jan.	26	1.00	26
	Feb.	26	1.31	34
	Mar.	23	1.56	36
	Apr.	14	1.71	24
	May	79	.75	59
	June	124	.73	91
1951	July	31	1.29	40
	Aug.	26	1.46	38
	Sept.	10	1.90	19
	Oct.	25	1.28	32
	Nov.	32	1.22	39
	Dec.	32	1.22	39
	Total	448	1.06	477
	Jan.	28	1.07	30
	Feb.	26	1.31	34
	Mar.	31	1.42	44
	Apr.	111	.60	67
	May	304	.34	103
	June	302	.33	100
1952	July	70	.79	55
	Aug.	49	.94	46
	Sept.	30	1.20	36
	Oct.	21	1.38	29
	Nov.	26	1.31	34
	Dec.	37	1.11	41
	Total	1,035	.60	619
	Jan.	39	0.90	35
	Feb.	33	1.12	37
	Mar.	34	1.41	48
	Apr.	13	1.77	23
	May	15	1.60	24
	June	107	.60	64
1953	July	13	1.77	23
	Aug.	12	1.75	21
	Sept.	5	2.20	11
	Oct.	9	2.00	18
	Nov.	20	1.40	28
	Dec.	26	1.31	34
	Total	326	1.12	366
	Jan.	27	1.11	30
	Feb.	25	1.28	32
	Mar.	20	1.80	36
	Apr.	13	1.77	23
	May	36	1.11	40
	June	5	2.40	12
1954	July	2	3.00	6
	Aug.	1	4.00	4
	Sept.	6	2.33	14
	Oct.	17	1.59	27
	Nov.	18	1.50	27
	Dec.	18	1.50	27
	Total	188	1.48	278
	Jan.	25	1.08	27
	Feb.	21	1.43	30
	Mar.	34	1.38	47
	Apr.	22	1.41	31
	May	45	1.00	45
	June	34	1.09	37
1955	July	2	3.00	6
	Aug.	8	2.25	17
	Sept.	4	2.50	10
	Oct.	6	2.33	14
	Nov.	15	1.60	24
	Dec.	29	1.21	35
	Total	245	1.32	323
	Jan.	27	1.00	27
	Feb.	23	1.35	31
	Mar.	25	1.60	40
	Apr.	17	1.59	27
	May	74	.76	56
	June	90	.68	61
1956	July	4	2.75	11
	Aug.	2	4.00	8
	Sept.	1	5.00	5
	Oct.	4	2.25	9
	Nov.	17	1.59	27
	Dec.	19	1.21	23
	Total	303	1.07	325
	Jan.	21	1.05	22
	Feb.	20	1.05	21
	Mar.	22	1.54	34
	Apr.	12	1.83	22
	May	39	1.23	48
	June	184	.41	75
1957	July	35	.91	32
	Aug.	18	1.61	29
	Sept.	15	1.47	22
	Oct.	19	1.74	33
	Nov.	41	1.41	58
	Dec.	30	1.07	32
	Total	456	.94	428
	Jan.	29	.83	24
	Feb.	31	1.00	31
	Mar.	35	1.37	48
	Apr.	29	1.07	31
	May	141	.46	65
	June	103	.42	43
1958	July	4	2.50	10
	Aug.	1	4.00	4
	Sept.	3	2.33	7
	Oct.	5	2.60	13
	Nov.	14	1.93	27
	Dec.	21	1.24	26
	Total	416	.79	329

To obtain mg/l multiply T/AF by 735.

Table 3
Colorado River Basin
Historical Flow and Quality of Water Data
Duchesne River near Randlett, Utah
Units – 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	22	1.14	25
	Feb.	24	1.04	25
	Mar.	17	1.29	22
	Apr.	5	2.00	10
	May	4	2.75	11
	June	34	.85	29
1959	July	6	2.00	12
	Aug.	4	2.75	11
	Sept.	4	2.50	10
	Oct.	11	1.54	17
	Nov.	13	1.54	20
	Dec.	22	1.32	29
	Total	166	1.33	221
	Jan.	23	.87	20
	Feb.	23	.83	19
	Mar.	27	1.15	31
	Apr.	8	1.62	13
	May	18	1.17	21
	June	23	.91	21
1960	July	1	4.00	4
	Aug.	1	4.00	4
	Sept.	1	4.00	4
	Oct.	5	2.40	12
	Nov.	12	1.58	19
	Dec.	18	1.33	24
	Total	160	1.20	192
	Jan.	21	1.19	25
	Feb.	19	1.47	28
	Mar.	10	1.50	15
	Apr.	2	3.50	7
	May	3	2.33	7
	June	3	2.67	8
1961	July	1	4.00	4
	Aug.	1	3.00	3
	Sept.	13	1.15	15
	Oct.	19	1.47	28
	Nov.	27	1.11	30
	Dec.	26	1.00	26
	Total	145	1.35	196
	Jan.	21	.81	17
	Feb.	43	.93	40
	Mar.	49	1.04	51
	Apr.	70	.69	48
	May	88	.64	56
	June	146	.47	69
1962	July	27	1.04	28
	Aug.	4	2.75	11
	Sept.	4	2.50	10
	Oct.	15	1.73	26
	Nov.	15	1.60	24
	Dec.	23	1.26	29
	Total	505	.81	409
	Jan.	18	1.17	21
	Feb.	29	1.14	33
	Mar.	10	1.90	19
	Apr.	5	3.20	16
	May	31	.97	30
	June	50	.76	38
1963	July	3	2.67	8
	Aug.	5	2.40	12
	Sept.	14	1.64	23
	Oct.	7	2.43	17
	Nov.	16	1.62	26
	Dec.	22	1.14	25
	Total	210	1.28	268
	Jan.	18	1.00	18
	Feb.	18	.94	17
	Mar.	23	1.04	24
	Apr.	14	1.57	22
	May	72	.68	49
	June	122	.66	81
1964	July	29	.97	28
	Aug.	6	2.17	13
	Sept.	4	2.75	11
	Oct.	5	2.80	14
	Nov.	18	1.67	30
	Dec.	27	1.26	34
	Total	356	.96	341
	Jan.	27	1.00	27
	Feb.	21	1.38	29
	Mar.	26	1.54	40
	Apr.	32	1.16	37
	May	71	1.11	79
	June	302	.49	148
1965	July	175	.51	80
	Aug.	57	.96	55
	Sept.	58	1.09	63
	Oct.	47	1.15	54
	Nov.	47	1.13	53
	Dec.	42	1.12	47
	Total	905	.80	721
	Jan.	39	.90	35
	Feb.	38	.74	28
	Mar.	47	1.02	48
	Apr.	35	1.20	42
	May	58	1.07	62
	June	16	1.81	29
1966	July	3	3.00	9
	Aug.	3	3.00	9
	Sept.	6	2.50	15
	Oct.	11	2.36	26
	Nov.	19	1.79	34
	Dec.	31	1.35	42
	Total	306	1.24	379
	Jan.	33	1.01	33
	Feb.	30	.98	29
	Mar.	41	1.44	59
	Apr.	19	1.71	32
	May	56	.82	46
	June	253	.45	114
1967	July	76	.70	53
	Aug.	11	1.89	21
	Sept.	10	2.05	20
	Oct.	12	2.17	26
	Nov.	18	1.74	31
	Dec.	32	1.02	33
	Total	591	.84	497
	Jan.	34	.85	29
	Feb.	34	1.12	38
	Mar.	40	1.49	60
	Apr.	31	1.61	50
	May	45	1.14	51
	June	250	.40	100
1968	July	24	1.23	30
	Aug.	26	1.40	36
	Sept.	13	1.91	25
	Oct.	20	1.77	35
	Nov.	27	1.45	39
	Dec.	38	1.03	39
	Total	582	.91	532

To obtain mg/l multiply T/AF by 735

Table 3

Colorado River Basin
Flow and Quality of Water Data
Duchesne River near Randlett, Utah
(Annual Summary)

Units — 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	694	0.75	554	523
1942	526	.88	647	463
1943	460	.99	725	454
1944	698	.74	544	517
1945	407	1.08	795	440
1946	324	1.16	851	375
1947	569	.86	632	489
1948	298	1.14	836	339
1949	641	.78	570	497
1950	574	.87	636	497
1951	448	1.06	783	477
1952	1,035	.60	440	619
1953	326	1.12	825	366
1954	188	1.48	1,087	278
1955	245	1.32	969	323
1956	303	1.07	788	325
1957	456	.94	690	428
1958	416	.79	581	329
1959	166	1.33	979	221
1960	160	1.20	882	192
1961	145	1.35	994	196
1962	505	.81	595	409
1963	210	1.28	938	268
1964	356	.96	704	341
1965	905	.80	586	721
1966	306	1.24	910	379
1967	591	.84	618	497
1968	582	.91	672	532
Total	12,534			11,495
Average	448	.92	674	411

Sampled quality record December 1950 to September 1951; November 1956 to December 1968; remainder by correlation.
Measured flow record October 1942 to December 1968; remainder by correlation.

Table 4

Colorado River Basin

Historical Flow and Quality of Water Data

Green River at Green River, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concen-tration (T./A.F.)	T.D.S. (Tons)
	Jan.	100	1.01	101
	Feb.	126	1.06	134
	Mar.	216	1.01	218
	Apr.	314	.75	235
	May	1,172	.53	621
	June	1,146	.49	562
-1941	July	359	.63	226
	Aug.	267	1.09	291
	Sept.	182	1.01	184
	Oct.	318	1.00	318
	Nov.	240	.90	216
	Dec.	168	.98	165
	Total	4,608	.71	3,271
	Jan.	112	1.04	117
	Feb.	122	.98	120
	Mar.	264	.94	248
	Apr.	858	.65	557
	May	980	.57	558
	June	1,271	.39	495
-1942	July	414	.57	236
	Aug.	152	.85	129
	Sept.	91	1.10	100
	Oct.	118	1.20	142
	Nov.	124	1.18	146
	Dec.	116	1.22	141
	Total	4,622	.65	2,989
	Jan.	112	1.13	127
	Feb.	130	1.02	132
	Mar.	236	.91	215
	Apr.	569	.57	325
	May	763	.39	298
	June	1,074	.40	430
-1943	July	612	.43	263
	Aug.	300	.83	249
	Sept.	116	.98	114
	Oct.	124	1.10	136
	Nov.	146	1.04	152
	Dec.	112	1.11	124
	Total	4,294	.60	2,565
	Jan.	80	1.20	96
	Feb.	111	1.06	118
	Mar.	253	1.07	271
	Apr.	529	.81	428
	May	924	.48	444
	June	1,391	.30	417
-1944	July	591	.44	260
	Aug.	143	.73	104
	Sept.	73	.96	70
	Oct.	115	1.13	130
	Nov.	119	1.14	136
	Dec.	88	1.23	108
	Total	4,417	.58	2,582
	Jan.	109	1.04	113
	Feb.	128	.99	127
	Mar.	185	1.03	191
	Apr.	291	.84	244
	May	909	.44	400
	June	1,016	.39	396
-1945	July	701	.41	287
	Aug.	335	.74	248
	Sept.	163	.77	125
	Oct.	161	.99	159
	Nov.	149	.99	148
	Dec.	113	1.06	120
	Total	4,260	.60	2,558
	Jan.	123	.95	117
	Feb.	117	.91	106
	Mar.	236	.90	212
	Apr.	528	.60	317
	May	775	.41	318
	June	746	.36	269
-1946	July	264	.47	124
	Aug.	152	.84	128
	Sept.	105	.91	96
	Oct.	149	1.00	149
	Nov.	170	.98	167
	Dec.	154	.94	145
	Total	3,519	.61	2,148
	Jan.	92	1.07	98
	Feb.	151	.86	130
	Mar.	411	.79	325
	Apr.	422	.59	249
	May	1,400	.38	532
	June	1,348	.39	526
-1947	July	656	.40	262
	Aug.	365	.71	259
	Sept.	166	.77	128
	Oct.	181	.91	165
	Nov.	179	.91	163
	Dec.	152	1.01	154
	Total	5,523	.54	2,991
	Jan.	141	.94	132
	Feb.	136	.91	124
	Mar.	313	.86	269
	Apr.	558	.69	385
	May	1,061	.39	414
	June	952	.34	324
-1948	July	268	.54	145
	Aug.	137	.81	111
	Sept.	69	.81	56
	Oct.	92	1.02	94
	Nov.	104	1.05	109
	Dec.	97	1.10	107
	Total	3,928	.58	2,270
	Jan.	100	1.01	101
	Feb.	110	.92	101
	Mar.	276	.92	254
	Apr.	474	.69	327
	May	1,221	.43	525
	June	1,547	.42	650
-1949	July	592	.57	338
	Aug.	172	.77	132
	Sept.	112	.89	100
	Oct.	207	.98	203
	Nov.	190	.90	171
	Dec.	128	1.07	137
	Total	5,129	.59	3,039
	Jan.	141	1.01	142
	Feb.	147	1.01	148
	Mar.	356	.90	321
	Apr.	620	.64	397
	May	1,026	.53	544
	June	1,567	.35	548
-1950	July	734	.49	360
	Aug.	246	.63	155
	Sept.	149	.89	133
	Oct.	153	.96	147
	Nov.	166	.99	164
	Dec.	171	.96	164
	Total	5,476	.59	3,223
	Jan.	113	1.13	128
	Feb.	167	.92	154
	Mar.	204	.93	190
	Apr.	372	.70	260
	May	882	.45	397
	June	1,309	.40	524
-1951	July	627	.43	270
	Aug.	379	.69	261
	Sept.	178	.79	140
	Oct.	211	.99	209
	Nov.	164	1.05	172
	Dec.	132	1.07	142
	Total	4,738	.60	2,847
	Jan.	135	1.01	136
	Feb.	140	.96	134
	Mar.	160	1.05	168
	Apr.	988	.88	869
	May	2,087	.48	1,002
	June	1,809	.36	651
-1952	July	514	.60	309
	Aug.	315	.89	280
	Sept.	184	.96	177
	Oct.	129	1.09	140
	Nov.	122	1.24	151
	Dec.	129	1.20	155
	Total	6,712	.62	4,172
	Jan.	140	1.05	147
	Feb.	141	1.04	147
	Mar.	217	1.00	217
	Apr.	221	.96	212
	May	454	.55	250
	June	1,167	.37	432
-1953	July	376	.48	181
	Aug.	212	.84	178
	Sept.	87	.99	86
	Oct.	86	1.20	104
	Nov.	126	1.15	145
	Dec.	107	1.18	126
	Total	3,334	.67	2,225
	Jan.	107	1.09	117
	Feb.	138	1.03	142
	Mar.	169	1.03	174
	Apr.	270	.75	202
	May	639	.38	243
	June	376	.45	169
-1954	July	346	.46	159
	Aug.	120	.65	78
	Sept.	134	1.02	137
	Oct.	139	1.14	159
	Nov.	120	1.06	127
	Dec.	80	1.25	100
	Total	2,638	.68	1,807
	Jan.	80	1.06	85
	Feb.	86	.92	79
	Mar.	237	.92	218
	Apr.	311	.77	239
	May	678	.39	264
	June	654	.36	236
-1955	July	223	.46	102
	Aug.	161	.83	134
	Sept.	71	.93	66
	Oct.	77	1.08	83
	Nov.	86	1.13	97
	Dec.	127	1.02	130
	Total	2,791	.62	1,733
	Jan.	155	.91	141
	Feb.	100	1.05	105
	Mar.	314	.81	255
	Apr.	460	.53	244
	May	995	.35	348
	June	1,207	.32	386
-1956	July	294	.49	144
	Aug.	169	.67	113
	Sept.	72	.72	52
	Oct.	77	.94	73
	Nov.	99	1.02	101
	Dec.	79	1.05	83
	Total	4,021	.51	2,045
	Jan.	83	.95	79
	Feb.	100	.94	94
	Mar.	237	.89	210
	Apr.	290	.73	212
	May	913	.48	438
	June	1,871	.34	636
-1957	July	1,164	.34	396
	Aug.	386	.79	305
	Sept.	202	.76	153
	Oct.	185	.94	174
	Nov.	228	.96	219
	Dec.	149	.97	144
	Total	5,808	.53	3,060
	Jan.	128	.93	119
	Feb.	184	.86	158
	Mar.	246	.92	227
	Apr.	432	.71	307
	May	1,311	.41	537
	June	1,174	.35	411
-1958	July	224	.62	139
	Aug.	110	.82	91
	Sept.	96	1.07	103
	Oct.	91	1.01	92
	Nov.	102	1.10	113
	Dec.	114	1.09	124
	Total	4,212	.57	2,421

To obtain mg/l multiply T/AF by 735.

Table 4

Colorado River Basin

Historical Flow and Quality of Water Data

Green River at Green River, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	97	1.13	110
	Feb.	114	.95	108
	Mar.	146	.94	137
	Apr.	219	.76	166
	May	480	.42	202
	June	763	.34	259
-1959	July	346	.51	176
	Aug.	179	.90	161
	Sept.	104	.92	96
	Oct.	178	.86	153
	Nov.	152	.83	126
	Dec.	106	1.02	108
	Total	2,884	.62	1,802
	Jan.	95	1.05	100
	Feb.	102	.95	97
	Mar.	320	.83	266
	Apr.	534	.51	272
	May	551	.39	215
	June	683	.33	225
-1960	July	170	.52	88
	Aug.	69	.76	52
	Sept.	59	.93	55
	Oct.	96	1.00	96
	Nov.	105	.90	94
	Dec.	80	1.06	85
	Total	2,864	.57	1,645
	Jan.	79	.98	77
	Feb.	94	.87	82
	Mar.	136	.89	121
	Apr.	184	.79	145
	May	342	.41	140
	June	542	.31	168
-1961	July	112	.49	55
	Aug.	80	.91	73
	Sept.	175	.99	173
	Oct.	234	.75	176
	Nov.	161	.80	129
	Dec.	126	.88	111
	Total	2,265	.64	1,450
	Jan.	115	.79	91
	Feb.	403	.72	290
	Mar.	401	.95	381
	Apr.	1,093	.56	612
	May	1,350	.36	486
	June	1,074	.38	408
-1962	July	598	.41	245
	Aug.	177	.61	108
	Sept.	98	.98	96
	Oct.	126	1.37	173
	Nov.	94	1.15	108
	Dec.	72	1.10	79
	Total	5,601	.55	3,077
	Jan.	71	1.04	74
	Feb.	120	.93	112
	Mar.	99	1.00	99
	Apr.	154	.68	105
	May	399	.40	160
	June	310	.42	130
-1963	July	51	.77	39
	Aug.	72	1.77	127
	Sept.	95	1.57	149
	Oct.	47	1.32	62
	Nov.	74	1.26	93
	Dec.	84	1.08	91
	Total	1,576	.79	1,241
	Jan.	109	.76	83
	Feb.	114	.76	87
	Mar.	128	.87	111
	Apr.	190	.89	169
	May	634	.45	285
	June	725	.40	290
-1964	July	344	.54	186
	Aug.	196	.93	182
	Sept.	139	.82	114
	Oct.	196	.78	153
	Nov.	200	.84	168
	Dec.	267	.81	216
	Total	3,242	.63	2,044

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	300	0.73	219
	Feb.	303	.82	248
	Mar.	361	.88	318
	Apr.	518	.79	409
	May	819	.46	377
	June	1,207	.42	507
-1965	July	546	.52	284
	Aug.	228	.94	214
	Sept.	189	.95	180
	Oct.	253	.85	215
	Nov.	239	.92	220
	Dec.	248	.89	221
	Total	5,211	.65	3,412
	Jan.	181	.86	156
	Feb.	166	.80	133
	Mar.	393	.80	314
	Apr.	390	.66	257
	May	566	.48	272
	June	325	.55	179
-1966	July	147	.85	125
	Aug.	147	.96	141
	Sept.	157	1.01	159
	Oct.	189	1.01	191
	Nov.	159	1.06	169
	Dec.	146	1.12	164
	Total	2,966	.76	2,260
	Jan.	196	.88	172
	Feb.	169	.90	152
	Mar.	256	.95	243
	Apr.	260	.77	200
	May	504	.54	272
	June	1,134	.52	590
-1967	July	508	.63	320
	Aug.	247	.99	245
	Sept	231	1.06	245
	Oct.	250	1.07	268
	Nov.	243	1.03	250
	Dec.	229	1.31	300
	Total	4,227	.77	3,257
	Jan.	249	.87	217
	Feb.	196	.91	178
	Mar.	241	1.05	253
	Apr.	275	.94	258
	May	708	.58	411
	June	1,248	.35	437
-1968	July	426	.65	277
	Aug.	345	1.02	352
	Sept.	241	.93	224
	Oct.	230	.99	228
	Nov.	221	.93	206
	Dec.	209	.88	184
	Total	4,589	.70	3,225
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 4
Colorado River Basin
Historical Flow and Quality of Water Data
Green River at Green River, Utah
(Annual Summary)

Units – 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	4,608	0.71	522	3,271
1942	4,622	.65	475	2,989
1943	4,294	.60	439	2,565
1944	4,417	.58	430	2,582
1945	4,260	.60	441	2,558
1946	3,519	.61	449	2,148
1947	5,523	.54	398	2,991
1948	3,928	.58	425	2,270
1949	5,129	.59	435	3,039
1950	5,476	.59	433	3,223
1951	4,738	.60	442	2,847
1952	6,712	.62	457	4,172
1953	3,334	.67	491	2,225
1954	2,638	.68	503	1,807
1955	2,791	.62	456	1,733
1956	4,021	.51	374	2,045
1957	5,808	.53	387	3,060
1958	4,212	.57	422	2,421
1959	2,884	.62	459	1,802
1960	2,864	.57	422	1,645
1961	2,265	.64	471	1,450
1962	5,601	.55	404	3,077
1963	1,576	.79	579	1,241
1964	3,242	.63	463	2,044
1965	5,211	.65	481	3,412
1966	2,966	.76	560	2,260
1967	4,227	.77	566	3,257
1968	4,589	.70	517	3,225
Total	115,455			71,359
Average	4,123	.62	454	2,549

Sampled quality record entire period.
Measured flow record entire period.

Table 5
Colorado River Basin
Historical Flow and Quality of Water Data
San Rafael River near Green River, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concen-tration (T./A.F.)	T.D.S. (Tons)
	Jan.	2	4.0	8
	Feb.	2	4.0	8
	Mar.	6	3.5	21
	Apr.	1	4.0	4
	May	50	1.2	62
	June	49	1.2	59
-1941	July	7	2.9	20
	Aug.	6	3.3	20
	Sept.	2	4.5	9
	Oct.	5	4.0	20
	Nov.	5	4.2	21
	Dec.	4	4.0	16
	Total	139	1.9	268
	Jan.	6	2.8	17
	Feb.	5	3.6	18
	Mar.	6	3.7	22
	Apr.	14	2.8	39
	May	34	1.4	49
	June	51	1.2	61
-1942	July	6	3.0	18
	Aug.	6	3.2	19
	Sept.	1	5.0	5
	Oct.	2	5.0	10
	Nov.	3	4.7	14
	Dec.	3	4.7	14
	Total	137	2.1	286
	Jan.	4	3.0	12
	Feb.	5	3.4	17
	Mar.	6	3.8	23
	Apr.	15	2.9	44
	May	13	2.1	27
	June	14	2.0	28
-1943	July	2	3.5	7
	Aug.	6	3.2	19
	Sept.	1	5.0	5
	Oct.	2	5.0	10
	Nov.	2	5.0	10
	Dec.	3	3.7	11
	Total	73	2.9	213
	Jan.	2	3.5	7
	Feb.	3	3.0	9
	Mar.	6	3.5	21
	Apr.	1	5.0	5
	May	40	1.3	53
	June	72	1.1	78
-1944	July	9	2.9	26
	Aug.	7	3.1	22
	Sept.	1	5.0	5
	Oct.	2	5.0	10
	Nov.	3	4.7	14
	Dec.	3	4.3	13
	Total	149	1.8	263
	Jan.	3	3.3	10
	Feb.	3	4.0	12
	Mar.	6	3.5	21
	Apr.	1	6.0	6
	May	22	1.6	35
	June	27	1.5	41
-1945	July	6	3.2	19
	Aug.	7	3.4	24
	Sept.	2	4.0	8
	Oct.	3	5.0	15
	Nov.	3	4.7	14
	Dec.	2	4.5	9
	Total	85	2.5	214
	Jan.	2	4.0	8
	Feb.	4	3.3	13
	Mar.	6	3.7	22
	Apr.	11	3.2	35
	May	20	1.8	36
	June	8	2.4	19
-1946	July	1	4.0	4
	Aug.	7	5.4	38
	Sept.	0	0	0
	Oct.	2	5.0	10
	Nov.	5	3.8	19
	Dec.	3	4.3	13
	Total	69	3.1	217
	Jan.	2	4.5	9
	Feb.	5	3.0	15
	Mar.	4	3.8	15
	Apr.	3	4.3	13
	May	33	1.4	46
	June	26	1.8	47
-1947	July	5	3.6	18
	Aug.	20	3.4	68
	Sept.	3	5.0	15
	Oct.	2	6.0	12
	Nov.	4	3.8	15
	Dec.	4	3.5	14
	Total	111	2.6	287
	Jan.	3	3.7	11
	Feb.	6	3.0	18
	Mar.	7	3.6	25
	Apr.	4	3.5	14
	May	16	1.4	23
	June	13	2.2	29
-1948	July	2	4.0	8
	Aug.	6	2.2	13
	Sept.	0	0	0
	Oct.	1	5.0	5
	Nov.	2	5.0	10
	Dec.	2	4.5	9
	Total	62	2.7	165
	Jan.	2	4.0	8
	Feb.	2	4.0	8
	Mar.	9	3.3	30
	Apr.	10	2.2	22
	May	30	1.3	38
	June	52	1.2	64
-1949	July	14	2.7	38
	Aug.	5	3.0	15
	Sept.	3	4.7	14
	Oct.	3	4.7	14
	Nov.	3	4.7	14
	Dec.	2	4.5	9
	Total	135	2.0	274
	Jan.	2	4.5	9
	Feb.	6	3.3	20
	Mar.	5	4.0	20
	Apr.	3	4.7	14
	May	9	2.2	20
	June	11	2.2	24
-1950	July	9	2.9	26
	Aug.	1	3.0	3
	Sept.	1	5.0	5
	Oct.	1	6.0	6
	Nov.	2	5.5	11
	Dec.	3	4.3	13
	Total	53	3.2	171
	Jan.	2	5.0	10
	Feb.	3	3.7	11
	Mar.	2	5.0	10
	Apr.	1	6.0	6
	May	15	1.9	29
	June	23	1.7	40
-1951	July	3	3.7	11
	Aug.	12	2.2	27
	Sept.	1	5.0	5
	Oct.	6	4.0	24
	Nov.	4	4.5	18
	Dec.	3	5.0	15
	Total	75	2.7	206
	Jan.	3	3.7	11
	Feb.	5	3.6	18
	Mar.	14	3.1	44
	Apr.	24	2.4	58
	May	93	.8	78
	June	128	.9	114
-1952	July	19	1.9	36
	Aug.	12	3.3	40
	Sept.	5	3.8	19
	Oct.	3	4.7	14
	Nov.	4	4.5	18
	Dec.	4	4.0	16
	Total	314	1.5	466
	Jan.	6	2.8	17
	Feb.	7	3.1	22
	Mar.	6	3.2	19
	Apr.	3	4.3	13
	May	2	5.5	11
	June	31	1.5	47
-1953	July	5	3.8	19
	Aug.	9	3.7	33
	Sept.	1	5.0	5
	Oct.	4	4.3	17
	Nov.	4	4.5	18
	Dec.	3	4.8	14
	Total	81	2.9	235
	Jan.	3	4.0	12
	Feb.	5	3.8	19
	Mar.	4	3.8	15
	Apr.	3	4.3	13
	May	8	2.9	23
	June	1	5.0	5
-1954	July	1	5.0	5
	Aug.	1	3.0	3
	Sept.	4	4.0	16
	Oct.	2	4.0	8
	Nov.	2	4.5	9
	Dec.	2	4.5	9
	Total	36	3.8	137
	Jan.	2	4.0	8
	Feb.	2	3.5	7
	Mar.	6	3.5	21
	Apr.	3	3.7	11
	May	4	3.0	12
	June	6	2.8	17
-1955	July	0	0	0
	Aug.	3	3.7	11
	Sept.	0	0	0
	Oct.	0	0	0
	Nov.	1	5.0	5
	Dec.	2	4.5	9
	Total	29	3.5	101
	Jan.	3	3.7	11
	Feb.	3	3.3	10
	Mar.	3	3.3	10
	Apr.	1	5.0	5
	May	11	1.6	18
	June	8	2.0	16
-1956	July	1	4.0	4
	Aug.	1	3.0	3
	Sept.	0	0	0
	Oct.	0	0	0
	Nov.	1	5.0	5
	Dec.	1	5.0	5
	Total	33	2.6	87
	Jan.	2	3.0	6
	Feb.	4	3.0	12
	Mar.	2	5.0	10
	Apr.	1	5.0	5
	May	9	3.1	28
	June	94	.8	79
-1957	July	24	1.5	37
	Aug.	13	2.8	36
	Sept.	4	3.5	14
	Oct.	10	3.3	33
	Nov.	21	2.5	53
	Dec.	5	3.4	17
	Total	189	1.7	330
	Jan.	5	2.6	13
	Feb.	8	2.8	22
	Mar.	6	3.3	20
	Apr.	13	1.6	21
	May	66	.9	60
	June	57	.8	47
-1958	July	2	4.0	8
	Aug.	4	4.5	18
	Sept.	4	4.3	17
	Oct.	1	5.0	5
	Nov.	2	4.0	8
	Dec.	4	3.3	13
	Total	172	1.5	252

To obtain mg/l multiply T/AF by 735.

Table 5
Colorado River Basin
Historical Flow and Quality of Water Data
San Rafael River near Green River, Utah
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	3	3.3	10
	Feb.	4	3.0	12
	Mar.	3	4.0	12
	Apr.	2	3.5	7
	May	1	5.0	5
	June	2	4.0	8
-1959	July	0	0	0
	Aug.	1	3.0	3
	Sept.	1	5.0	5
	Oct.	1	4.0	4
	Nov.	2	4.0	8
	Dec.	1	7.0	7
	Total	21	3.9	81
	Jan.	1	6.0	6
	Feb.	2	3.5	7
	Mar.	8	2.8	22
	Apr.	3	3.3	10
	May	8	1.9	15
	June	11	1.5	17
-1960	July	0	0	0
	Aug.	0	0	0
	Sept.	1	4.0	4
	Oct.	8	2.5	20
	Nov.	2	4.5	9
	Dec.	2	4.0	8
	Total	46	2.6	118
	Jan.	2	3.5	7
	Feb.	3	2.7	8
	Mar.	2	5.5	11
	Apr.	2	4.0	8
	May	3	3.0	9
	June	2	2.5	5
-1961	July	0	0	0
	Aug.	7	2.9	20
	Sept.	18	2.9	53
	Oct.	3	4.0	12
	Nov.	4	3.5	14
	Dec.	2	4.5	9
	Total	48	3.3	156
	Jan.	2	4.0	8
	Feb.	8	2.5	20
	Mar.	6	2.8	17
	Apr.	11	1.3	14
	May	29	1.1	31
	June	37	1.0	37
-1962	July	7	2.6	18
	Aug.	1	4.0	4
	Sept.	3	3.0	9
	Oct.	4	4.5	18
	Nov.	2	5.5	11
	Dec.	2	5.5	11
	Total	112	1.8	198
	Jan.	2	5.5	11
	Feb.	4	3.2	13
	Mar.	2	5.5	11
	Apr.	1	6.0	6
	May	6	2.3	14
	June	10	2.2	22
-1963	July	1	2.0	2
	Aug.	9	3.8	34
	Sept.	6	4.3	26
	Oct.	1	6.0	6
	Nov.	2	4.5	9
	Dec.	2	4.5	9
	Total	46	3.5	163
	Jan.	1	6.0	6
	Feb.	2	4.0	8
	Mar.	3	3.7	11
	Apr.	1	8.0	8
	May	15	1.9	29
	June	20	1.6	33
-1964	July	4	3.8	15
	Aug.	6	3.7	22
	Sept.	1	4.0	4
	Oct.	0	0	0
	Nov.	1	7.0	7
	Dec.	3	4.7	14
	Total	57	2.7	157

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	4	3.5	14
	Feb.	3	3.7	11
	Mar.	3	4.0	12
	Apr.	6	2.7	16
	May	18	1.6	28
	June	77	.9	70
-1965	July	38	1.6	60
	Aug.	16	2.5	40
	Sept.	5	4.0	20
	Oct.	4	4.5	18
	Nov.	5	4.8	24
	Dec.	5	3.2	16
	Total	184	1.8	329
	Jan.	3	3.7	11
	Feb.	3	3.7	11
	Mar.	8	3.5	28
	Apr.	4	3.0	12
	May	4	4.5	18
	June	2	4.0	8
-1966	July	2	4.5	9
	Aug.	1	3.0	3
	Sept.	2	5.0	10
	Oct.	1	8.0	8
	Nov.	1	5.0	5
	Dec.	2	5.0	10
	Total	33	4.0	133
	Jan.	1	4.8	5
	Feb.	2	3.8	8
	Mar.	2	4.6	9
	Apr.	1	5.8	6
	May	5	3.2	16
	June	22	2.0	44
-1967	July	7	2.9	21
	Aug.	3	3.3	10
	Sept.	5	3.6	18
	Oct.	2	4.6	9
	Nov.	2	4.5	9
	Dec.	2	5.0	10
	Total	54	3.1	165
	Jan.	2	5.0	10
	Feb.	3	4.1	12
	Mar.	3	5.2	16
	Apr.	2	4.8	10
	May	6	3.8	23
	June	25	1.3	33
-1968	July	6	3.6	21
	Aug.	11	3.3	36
	Sept.	4	3.9	16
	Oct.	5	4.3	21
	Nov.	3	4.1	12
	Dec.	2	4.7	9
	Total	72	3.0	219
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 5
Colorado River Basin
Historical Flow and Quality of Water Data
San Rafael River near Green River, Utah

(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	139	1.9	1,420	268
1942	137	2.1	1,530	286
1943	73	2.9	2,140	213
1944	149	1.8	1,300	263
1945	85	2.5	1,850	214
1946	69	3.1	2,310	217
1947	111	2.6	1,900	287
1948	62	2.7	1,960	165
1949	135	2.0	1,490	274
1950	53	3.2	2,370	171
1951	75	2.7	2,020	206
1952	314	1.5	1,090	466
1953	81	2.9	2,130	235
1954	36	3.8	2,800	137
1955	29	3.5	2,560	101
1956	33	2.6	1,940	87
1957	189	1.7	1,280	330
1958	172	1.5	1,080	252
1959	21	3.9	2,840	81
1960	46	2.6	1,890	118
1961	48	3.3	2,390	156
1962	112	1.8	1,300	198
1963	46	3.5	2,600	163
1964	57	2.7	2,020	157
1965	184	1.8	1,310	329
1966	33	4.0	2,960	133
1967	54	3.1	2,250	165
1968	72	3.0	2,240	219
Total	2,615			5,891
Average	93	2.3	1,660	210

Sampled quality record November 1946 to September 1949; November 1950 to December 1968; remainder by correlation.
Measured flow record October 1945 to December 1968, remainder by correlation.

Table 6

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Glenwood Springs, Colorado

Units – 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	36	0.75	27
	Feb.	37	.59	22
	Mar.	51	.60	30
	Apr.	85	.47	40
	May	535	.22	118
	June	470	.19	90
- 1941	July	163	.37	60
	Aug.	84	.60	50
	Sept.	67	.60	40
	Oct.	78	.58	45
	Nov.	59	.63	37
	Dec.	48	.67	32
	Total	1,713	.34	591
	Jan.	43	.74	32
	Feb.	41	.68	28
	Mar.	46	.70	32
	Apr.	167	.42	70
	May	389	.24	93
	June	721	.16	116
- 1942	July	230	.27	62
	Aug.	78	.53	41
	Sept.	46	.78	36
	Oct.	53	.75	40
	Nov.	49	.76	37
	Dec.	40	.82	33
	Total	1,903	.33	620
	Jan.	37	.86	32
	Feb.	36	.78	28
	Mar.	48	.75	36
	Apr.	162	.34	55
	May	342	.23	79
	June	582	.18	105
- 1943	July	254	.28	71
	Aug.	109	.45	49
	Sept.	66	.64	42
	Oct.	60	.67	40
	Nov.	67	.54	36
	Dec.	64	.53	34
	Total	1,827	.33	607
	Jan.	37	.76	28
	Feb.	44	.66	29
	Mar.	50	.72	36
	Apr.	85	.51	43
	May	302	.26	78
	June	498	.16	80
- 1944	July	185	.29	54
	Aug.	72	.49	35
	Sept.	45	.71	32
	Oct.	60	.65	39
	Nov.	57	.63	36
	Dec.	59	.56	33
	Total	1,494	.35	523
	Jan.	41	.71	29
	Feb.	37	.68	25
	Mar.	62	.50	31
	Apr.	72	.51	37
	May	347	.22	76
	June	461	.18	83
- 1945	July	268	.26	70
	Aug.	181	.33	60
	Sept.	73	.52	38
	Oct.	78	.49	38
	Nov.	73	.47	34
	Dec.	71	.45	32
	Total	1,764	.31	553
	Jan.	67	.48	32
	Feb.	54	.54	29
	Mar.	64	.55	35
	Apr.	197	.28	55
	May	284	.22	62
	June	362	.22	80
- 1946	July	164	.40	65
	Aug.	83	.51	42
	Sept.	59	.66	39
	Oct.	70	.61	43
	Nov.	61	.59	36
	Dec.	77	.40	31
	Total	1,542	.36	549

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	52	0.60	31
	Feb.	54	.61	33
	Mar.	68	.53	36
	Apr.	123	.37	46
	May	486	.19	92
	June	606	.17	103
- 1947	July	438	.21	92
	Aug.	147	.38	56
	Sept.	79	.53	42
	Oct.	90	.47	42
	Nov.	80	.49	39
	Dec.	75	.48	36
	Total	2,298	.28	648
	Jan.	76	.45	34
	Feb.	72	.44	32
	Mar.	68	.50	34
	Apr.	162	.37	60
	May	542	.20	108
	June	470	.18	85
- 1948	July	156	.35	55
	Aug.	90	.51	46
	Sept.	57	.67	38
	Oct.	63	.65	41
	Nov.	66	.53	35
	Dec.	59	.61	36
	Total	1,881	.32	604
	Jan.	67	.54	36
	Feb.	56	.57	32
	Mar.	58	.59	34
	Apr.	132	.38	50
	May	364	.23	84
	June	654	.19	124
- 1949	July	356	.24	85
	Aug.	106	.45	48
	Sept.	69	.59	41
	Oct.	61	.70	43
	Nov.	55	.71	39
	Dec.	58	.62	36
	Total	2,036	.32	652
	Jan.	56	.63	35
	Feb.	54	.56	30
	Mar.	80	.44	35
	Apr.	141	.35	49
	May	259	.26	67
	June	429	.20	86
- 1950	July	137	.42	58
	Aug.	79	.50	40
	Sept.	66	.58	38
	Oct.	49	.80	39
	Nov.	53	.70	37
	Dec.	55	.61	34
	Total	1,458	.38	548
	Jan.	59	.56	33
	Feb.	58	.52	30
	Mar.	58	.55	32
	Apr.	104	.40	42
	May	381	.23	88
	June	536	.20	107
- 1951	July	285	.25	71
	Aug.	132	.43	57
	Sept.	77	.58	45
	Oct.	75	.61	46
	Nov.	63	.57	36
	Dec.	63	.51	32
	Total	1,891	.33	619
	Jan.	53	.60	32
	Feb.	47	.62	29
	Mar.	63	.51	32
	Apr.	194	.38	74
	May	597	.23	137
	June	785	.19	149
- 1952	July	245	.34	83
	Aug.	157	.51	80
	Sept.	99	.54	53
	Oct.	77	.58	45
	Nov.	66	.64	42
	Dec.	60	.58	35
	Total	2,443	.32	791

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	64	0.59	38
	Feb.	53	.57	30
	Mar.	67	.54	37
	Apr.	103	.46	47
	May	229	.32	73
	June	509	.20	102
- 1953	July	171	.41	70
	Aug.	121	.50	60
	Sept.	69	.58	40
	Oct.	64	.63	40
	Nov.	55	.75	41
	Dec.	58	.66	38
	Total	1,563	.39	616
	Jan.	62	.58	36
	Feb.	48	.62	30
	Mar.	62	.58	36
	Apr.	86	.44	38
	May	146	.35	51
	June	89	.52	46
- 1954	July	83	.55	46
	Aug.	74	.58	43
	Sept.	59	.61	36
	Oct.	58	.66	38
	Nov.	48	.71	34
	Dec.	40	.90	36
	Total	855	.55	470
	Jan.	38	.79	30
	Feb.	34	.82	28
	Mar.	43	.79	34
	Apr.	90	.48	43
	May	206	.28	58
	June	217	.31	67
- 1955	July	99	.56	56
	Aug.	86	.66	57
	Sept.	67	.57	38
	Oct.	61	.62	38
	Nov.	55	.69	38
	Dec.	55	.60	33
	Total	1,051	.49	520
	Jan.	52	.60	31
	Feb.	48	.56	27
	Mar.	69	.59	41
	Apr.	120	.44	53
	May	421	.26	110
	June	329	.24	79
- 1956	July	104	.54	56
	Aug.	82	.61	50
	Sept.	73	.55	40
	Oct.	66	.55	36
	Nov.	50	.72	36
	Dec.	41	.78	32
	Total	1,455	.41	591
	Jan.	46	.72	33
	Feb.	44	.68	30
	Mar.	51	.67	34
	Apr.	92	.53	49
	May	350	.32	112
	June	834	.21	175
- 1957	July	571	.22	126
	Aug.	176	.37	65
	Sept.	88	.56	49
	Oct.	75	.60	45
	Nov.	72	.58	42
	Dec.	63	.59	37
	Total	2,462	.32	797
	Jan.	62	.55	34
	Feb.	58	.50	29
	Mar.	73	.52	38
	Apr.	102	.45	46
	May	546	.22	120
	June	439	.21	92
- 1958	July	104	.51	53
	Aug.	67	.59	40
	Sept.	62	.58	36
	Oct.	59	.63	37
	Nov.	54	.68	37
	Dec.	54	.63	34
	Total	1,680	.35	596

To obtain mg/l multiply T/AF by 735.

Table 6
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Glenwood Springs, Colorado
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	63	0.54	34
	Feb.	54	.52	28
	Mar.	49	.65	32
	Apr.	81	.54	44
	May	252	.29	73
	June	342	.25	85
- 1959	July	126	.48	61
	Aug.	89	.61	54
	Sept.	73	.56	41
	Oct.	84	.55	46
	Nov.	69	.55	38
	Dec.	59	.53	31
	Total	1,341	.42	567
	Jan.	67	.49	33
	Feb.	55	.50	28
	Mar.	93	.47	44
	Apr.	166	.32	53
	May	288	.25	72
	June	357	.25	89
- 1960	July	122	.49	60
	Aug.	73	.60	44
	Sept.	67	.60	40
	Oct.	61	.62	38
	Nov.	56	.61	34
	Dec.	61	.54	33
	Total	1,466	.39	568
	Jan.	65	.52	34
	Feb.	56	.53	30
	Mar.	55	.59	32
	Apr.	66	.54	36
	May	207	.29	60
	June	203	.28	57
- 1961	July	82	.60	49
	Aug.	80	.59	47
	Sept.	109	.50	54
	Oct.	128	.43	55
	Nov.	81	.50	40
	Dec.	77	.47	36
	Total	1,209	.44	530
	Jan.	80	.44	35
	Feb.	91	.42	38
	Mar.	122	.39	48
	Apr.	347	.32	111
	May	539	.23	125
	June	455	.23	105
- 1962	July	288	.29	84
	Aug.	110	.50	55
	Sept.	74	.58	43
	Oct.	127	.42	53
	Nov.	102	.47	48
	Dec.	72	.57	41
	Total	2,407	.33	786
	Jan.	55	.67	37
	Feb.	53	.63	33
	Mar.	62	.58	36
	Apr.	81	.48	39
	May	175	.31	54
	June	122	.45	55
- 1963	July	66	.66	44
	Aug.	77	.60	46
	Sept.	76	.57	43
	Oct.	63	.61	38
	Nov.	54	.66	36
	Dec.	38	.82	31
	Total	922	.53	492
	Jan.	36	.80	29
	Feb.	33	.78	26
	Mar.	39	.71	28
	Apr.	64	.61	39
	May	210	.32	67
	June	215	.31	67
- 1964	July	99	.63	62
	Aug.	87	.61	53
	Sept.	72	.60	43
	Oct.	65	.64	42
	Nov.	50	.72	36
	Dec.	51	.73	37
	Total	1,021	.52	529
	Jan.	51	0.70	36
	Feb.	44	.72	32
	Mar.	49	.69	34
	Apr.	104	.50	52
	May	263	.30	79
	June	446	.26	116
- 1965	July	271	.31	84
	Aug.	172	.39	67
	Sept.	95	.50	48
	Oct.	95	.44	42
	Nov.	86	.46	39
	Dec.	88	.47	41
	Total	1,764	.38	670
	Jan.	78	0.48	37
	Feb.	70	.45	32
	Mar.	91	.46	42
	Apr.	84	.47	39
	May	186	.30	56
	June	110	.45	50
- 1966	July	89	.51	45
	Aug.	77	.46	35
	Sept.	68	.51	35
	Oct.	72	.60	43
	Nov.	55	.66	36
	Dec.	44	.75	33
	Total	1,024	.47	483
	Jan.	49	.65	32
	Feb.	45	.62	28
	Mar.	67	.59	40
	Apr.	96	.45	43
	May	185	.31	57
	June	250	.28	70
- 1967	July	139	.47	65
	Aug.	90	.57	51
	Sept.	83	.59	49
	Oct.	78	.59	46
	Nov.	69	.57	39
	Dec.	59	.59	35
	Total	1,210	.46	555
	Jan.	53	.61	32
	Feb.	53	.55	29
	Mar.	62	.55	34
	Apr.	95	.46	44
	May	171	.36	62
	June	369	.25	92
- 1968	July	133	.46	61
	Aug.	125	.48	60
	Sept.	79	.53	42
	Oct.	77	.55	42
	Nov.	68	.54	37
	Dec.	65	.59	38
	Total	1,350	.42	573

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 6
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Glenwood Springs, Colorado

(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	1,713	0.34	254	591
1942	1,903	.33	239	620
1943	1,827	.33	244	607
1944	1,494	.35	257	523
1945	1,764	.31	230	553
1946	1,542	.36	262	549
1947	2,298	.28	207	648
1948	1,881	.32	236	604
1949	2,036	.32	235	652
1950	1,458	.38	276	548
1951	1,891	.33	241	619
1952	2,443	.32	238	791
1953	1,563	.39	290	616
1954	855	.55	404	470
1955	1,051	.49	364	520
1956	1,455	.41	299	591
1957	2,462	.32	238	797
1958	1,680	.35	261	596
1959	1,341	.42	311	567
1960	1,466	.39	285	568
1961	1,209	.44	322	530
1962	2,407	.33	240	786
1963	922	.53	392	492
1964	1,021	.52	381	529
1965	1,764	.38	279	670
1966	1,024	.47	347	483
1967	1,210	.46	337	555
1968	1,350	.42	312	573
Total	45,030			16,648
Average	1,608	.37	272	595

Sampled quality record October 1941 to December 1968; remainder by correlation.

Measured flow record entire period.

Table 7
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Cameo, Colorado
Units - 1000

Year	Month	Flow (A.F.)	Concen-tration (T./A.F.)	T.D.S. (Tons)
	Jan.	65	1.23	80
	Feb.	67	1.15	77
	Mar.	82	1.11	91
	Apr.	133	.83	110
	May	948	.34	322
	June	803	.28	225
-1941	July	315	.47	148
	Aug.	144	.91	131
	Sept.	122	.97	118
	Oct.	166	.88	146
	Nov.	124	.96	119
	Dec.	103	1.11	114
	Total	3,072	.55	1,681
	Jan.	90	1.24	112
	Feb.	86	1.19	102
	Mar.	103	1.13	116
	Apr.	334	.62	207
	May	757	.41	310
	June	1,215	.24	292
-1942	July	406	.44	179
	Aug.	139	.85	118
	Sept.	86	1.15	99
	Oct.	94	1.18	111
	Nov.	94	1.24	117
	Dec.	84	1.26	106
	Total	3,488	.54	1,869
	Jan.	77	1.30	100
	Feb.	74	1.26	93
	Mar.	89	1.22	109
	Apr.	237	.56	133
	May	509	.32	163
	June	931	.23	214
-1943	July	387	.39	151
	Aug.	192	.73	140
	Sept.	117	.89	104
	Oct.	111	1.00	111
	Nov.	115	.90	103
	Dec.	107	.93	100
	Total	2,946	.52	1,521
	Jan.	74	1.24	92
	Feb.	76	1.11	84
	Mar.	81	1.11	90
	Apr.	118	.85	100
	May	564	.36	203
	June	890	.24	214
-1944	July	378	.38	143
	Aug.	123	.80	98
	Sept.	78	1.09	85
	Oct.	99	1.05	104
	Nov.	100	1.01	101
	Dec.	99	1.02	101
	Total	2,680	.53	1,415
	Jan.	78	1.15	90
	Feb.	72	1.18	85
	Mar.	95	.99	94
	Apr.	115	.90	104
	May	601	.36	216
	June	794	.27	214
-1945	July	499	.33	165
	Aug.	287	.52	149
	Sept.	118	.83	98
	Oct.	126	.79	100
	Nov.	125	.81	101
	Dec.	117	.89	104
	Total	3,027	.50	1,520
	Jan.	109	.90	98
	Feb.	91	.97	88
	Mar.	99	.94	93
	Apr.	285	.45	128
	May	449	.32	144
	June	689	.28	193
-1946	July	267	.51	136
	Aug.	126	.85	107
	Sept.	92	1.01	93
	Oct.	122	.89	109
	Nov.	104	.92	96
	Dec.	121	.82	99
	Total	2,554	.54	1,384

Year	Month	Flow (A.F.)	Concen-tration (T./A.F.)	T.D.S. (Tons)
	Jan.	82	1.04	85
	Feb.	82	.99	81
	Mar.	107	.96	103
	Apr.	178	.63	112
	May	809	.28	227
	June	1,027	.25	257
-1947	July	732	.27	198
	Aug.	240	.58	139
	Sept.	143	.78	111
	Oct.	153	.80	122
	Nov.	135	.77	104
	Dec.	118	.86	102
	Total	3,806	.43	1,641
	Jan.	116	.84	97
	Feb.	111	.81	90
	Mar.	115	.90	104
	Apr.	253	.59	149
	May	920	.30	276
	June	844	.26	219
-1948	July	312	.47	146
	Aug.	161	.77	124
	Sept.	88	1.03	91
	Oct.	109	1.02	111
	Nov.	107	.96	103
	Dec.	90	1.04	94
	Total	3,226	.50	1,604
	Jan.	99	.96	95
	Feb.	84	.92	77
	Mar.	98	.98	96
	Apr.	201	.65	131
	May	572	.36	206
	June	1,080	.26	281
-1949	July	594	.34	202
	Aug.	184	.69	127
	Sept.	122	.93	113
	Oct.	125	.98	123
	Nov.	108	1.01	109
	Dec.	101	1.05	106
	Total	3,368	.49	1,666
	Jan.	91	1.04	95
	Feb.	88	.95	84
	Mar.	118	.87	103
	Apr.	212	.59	125
	May	418	.40	167
	June	787	.27	212
-1950	July	273	.54	147
	Aug.	125	.87	109
	Sept.	111	.97	108
	Oct.	97	1.19	115
	Nov.	98	1.14	112
	Dec.	98	1.07	105
	Total	2,516	.59	1,482
	Jan.	96	1.01	97
	Feb.	88	.95	84
	Mar.	99	1.01	100
	Apr.	151	.70	106
	May	537	.34	183
	June	858	.27	232
-1951	July	471	.36	170
	Aug.	207	.68	141
	Sept.	111	.90	100
	Oct.	120	.92	110
	Nov.	104	.97	101
	Dec.	106	.96	102
	Total	2,948	.52	1,526
	Jan.	96	1.01	97
	Feb.	84	1.06	89
	Mar.	113	.99	112
	Apr.	313	.60	188
	May	978	.36	352
	June	1,320	.26	343
-1952	July	449	.44	197
	Aug.	276	.70	193
	Sept.	171	.78	133
	Oct.	123	.97	119
	Nov.	112	1.04	117
	Dec.	99	1.12	111
	Total	4,134	.50	2,051

Year	Month	Flow (A.F.)	Concen-tration (T./A.F.)	T.D.S. (Tons)
	Jan.	99	1.03	102
	Feb.	80	1.06	85
	Mar.	102	.96	98
	Apr.	136	.78	106
	May	346	.44	152
	June	887	.27	239
-1953	July	294	.52	153
	Aug.	194	.72	140
	Sept.	101	.99	100
	Oct.	101	1.06	107
	Nov.	99	1.13	112
	Dec.	92	1.17	108
	Total	2,531	.59	1,502
	Jan.	95	1.00	95
	Feb.	81	1.05	85
	Mar.	94	1.01	95
	Apr.	136	.78	106
	May	296	.48	142
	June	204	.60	123
-1954	July	146	.81	118
	Aug.	105	.97	102
	Sept.	103	1.07	110
	Oct.	125	.97	121
	Nov.	98	1.07	105
	Dec.	82	1.23	101
	Total	1,565	.83	1,303
	Jan.	74	1.23	91
	Feb.	67	1.25	84
	Mar.	86	1.13	97
	Apr.	142	.77	110
	May	384	.42	161
	June	448	.37	166
-1955	July	214	.61	130
	Aug.	157	.87	137
	Sept.	100	.94	94
	Oct.	91	1.02	93
	Nov.	94	1.06	100
	Dec.	89	1.07	95
	Total	1,946	.70	1,358
	Jan.	81	1.07	87
	Feb.	75	1.11	83
	Mar.	104	.98	102
	Apr.	184	.66	122
	May	685	.34	233
	June	637	.31	197
-1956	July	173	.70	121
	Aug.	115	.95	109
	Sept.	88	.90	79
	Oct.	93	.95	88
	Nov.	83	1.07	89
	Dec.	73	1.21	88
	Total	2,391	.59	1,398
	Jan.	80	1.10	88
	Feb.	77	1.10	85
	Mar.	83	1.16	96
	Apr.	151	.83	125
	May	591	.47	278
	June	1,415	.27	382
-1957	July	1,072	.27	289
	Aug.	339	.50	170
	Sept.	157	.78	122
	Oct.	136	.89	121
	Nov.	123	.91	112
	Dec.	102	.96	98
	Total	4,326	.45	1,966
	Jan.	92	.93	86
	Feb.	95	.93	88
	Mar.	123	.89	110
	Apr.	171	.76	130
	May	847	.31	263
	June	808	.27	218
-1958	July	193	.67	129
	Aug.	109	.97	106
	Sept.	103	1.03	106
	Oct.	99	1.09	108
	Nov.	94	1.09	102
	Dec.	86	1.12	96
	Total	2,820	.55	1,542

To obtain mg/l multiply T/AF by 735

Table 7

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cameo, Colorado

Units-1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	94	1.02	96
	Feb.	86	1.01	87
	Mar.	83	1.09	90
	Apr.	118	.83	98
	May	392	.40	157
	June	684	.29	198
-1959	July	215	.59	127
	Aug.	131	.87	114
	Sept.	105	.98	103
	Oct.	138	.81	112
	Nov.	116	.87	101
	Dec.	100	.98	98
	Total	2,262	.61	1,381
	Jan.	100	.89	89
	Feb.	91	.95	86
	Mar.	135	.78	105
	Apr.	246	.51	125
	May	432	.37	160
	June	668	.30	200
-1960	July	217	.60	130
	Aug.	117	.89	104
	Sept	102	.95	97
	Oct.	106	1.00	106
	Nov.	99	1.05	104
	Dec.	100	1.01	101
	Total	2,413	.58	1,407
	Jan.	99	.97	96
	Feb.	85	.94	80
	Mar.	86	1.06	91
	Apr.	103	.91	94
	May	354	.40	142
	June	426	.34	145
-1961	July	138	.81	112
	Aug.	115	.89	102
	Sept.	175	.73	128
	Oct.	200	.59	118
	Nov.	131	.73	96
	Dec.	121	.78	94
	Total	2,033	.64	1,298
	Jan.	115	.78	90
	Feb.	135	.74	100
	Mar.	160	.69	110
	Apr.	513	.40	205
	May	892	.31	277
	June	882	.27	238
-1962	July	545	.37	202
	Aug.	186	.72	134
	Sept.	121	.95	115
	Oct.	173	.74	128
	Nov.	148	.79	117
	Dec.	115	.99	114
	Total	3,985	.46	1,830
	Jan.	95	1.11	105
	Feb.	87	.98	85
	Mar.	98	1.02	100
	Apr.	127	.79	100
	May	323	.40	129
	June	246	.53	130
-1963	July	111	.91	101
	Aug.	115	.92	106
	Sept.	112	.89	100
	Oct.	96	.99	95
	Nov.	90	1.09	98
	Dec.	71	1.32	94
	Total	1,571	.79	1,243
	Jan.	58	1.29	75
	Feb.	55	1.19	65
	Mar.	67	1.13	76
	Apr.	105	.92	97
	May	403	.41	165
	June	465	.35	163
-1964	July	223	.62	138
	Aug.	153	.81	124
	Sept.	116	.86	100
	Oct.	104	1.01	105
	Nov.	94	1.11	104
	Dec.	91	1.08	98
	Total	1,934	.68	1,310

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	92	1.10	101
	Feb.	78	1.09	85
	Mar.	85	1.15	98
	Apr.	161	.69	111
	May	477	.39	186
	June	920	.28	258
-1965	July	605	.34	206
	Aug.	273	.56	153
	Sept.	172	.75	129
	Oct.	167	.75	125
	Nov.	137	.75	103
	Dec.	138	.75	103
	Total	3,305	.50	1,658
	Jan.	114	.82	93
	Feb.	99	.81	80
	Mar.	133	.77	102
	Apr.	141	.66	93
	May	373	.40	149
	June	277	.48	133
-1966	July	157	.73	115
	Aug.	119	.87	104
	Sept.	101	.94	95
	Oct.	108	.98	106
	Nov.	93	1.05	98
	Dec.	85	1.22	104
	Total	1,800	.71	1,272
	Jan.	86	1.11	95
	Feb.	74	1.06	78
	Mar.	106	.93	99
	Apr.	137	.72	99
	May	328	.43	141
	June	543	.31	168
-1967	July	289	.53	153
	Aug.	137	.83	114
	Sept.	125	.90	112
	Oct.	115	.92	106
	Nov.	104	.95	99
	Dec.	100	1.00	100
	Total	2,144	.64	1,364
	Jan.	89	1.12	100
	Feb.	87	.98	85
	Mar.	96	1.01	97
	Apr.	133	.77	102
	May	326	.43	140
	June	757	.27	204
-1968	July	257	.57	146
	Aug.	224	.67	150
	Sept.	125	.86	108
	Oct.	128	.91	116
	Nov.	113	.95	107
	Dec.	104	.99	103
	Total	2,439	.60	1,458
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 7
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Cameo, Colorado
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	3,072	0.55	402	1,681
1942	3,489	.54	394	1,869
1943	2,946	.52	379	1,521
1944	2,680	.53	388	1,415
1945	3,027	.50	369	1,520
1946	2,554	.54	398	1,384
1947	3,806	.43	317	1,641
1948	3,226	.50	365	1,604
1949	3,368	.49	364	1,666
1950	2,516	.59	433	1,482
1951	2,948	.52	380	1,526
1952	4,134	.50	365	2,051
1953	2,531	.59	436	1,502
1954	1,565	.83	612	1,303
1955	1,946	.70	513	1,358
1956	2,391	.59	430	1,398
1957	4,326	.45	334	1,966
1958	2,820	.55	402	1,542
1959	2,262	.61	449	1,381
1960	2,413	.58	429	1,407
1961	2,033	.64	469	1,298
1962	3,985	.46	338	1,830
1963	1,571	.79	582	1,243
1964	1,934	.68	498	1,310
1965	3,035	.50	369	1,658
1966	1,800	.71	519	1,272
1967	2,144	.64	468	1,364
1968	2,439	.60	439	1,458
Total	77,229			42,651
Average	2,758	.55	406	1,523

Sampled quality record entire period.
Measured flow record entire period.

Table 8
Colorado River Basin
Historical Flow and Quality of Water Data
Gunnison River near Grand Junction, Colorado

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	51	1.90	97
	Feb.	51	1.82	93
	Mar.	63	1.67	105
	Apr.	123	1.00	123
	May	871	.40	349
	June	563	.46	259
-1941	July	192	.94	180
	Aug.	95	1.41	134
	Sept.	81	2.11	171
	Oct.	198	1.35	267
	Nov.	121	1.33	161
	Dec.	84	1.58	133
	Total	2,493	.83	2,072
	Jan.	71	1.59	113
	Feb.	62	1.66	103
	Mar.	76	1.64	125
	Apr.	546	.52	284
	May	760	.47	357
	June	688	.38	261
-1942	July	167	.93	156
	Aug.	68	2.18	148
	Sept.	56	2.36	132
	Oct.	57	2.58	147
	Nov.	65	1.92	125
	Dec.	58	1.83	106
	Total	2,674	.77	2,057
	Jan.	57	1.72	98
	Feb.	48	1.60	77
	Mar.	56	1.55	87
	Apr.	279	.44	123
	May	389	.48	187
	June	397	.46	183
-1943	July	113	1.08	122
	Aug.	153	1.43	219
	Sept.	87	1.59	138
	Oct.	69	1.84	127
	Nov.	75	1.59	119
	Dec.	61	1.57	96
	Total	1,784	.88	1,576
	Jan.	51	1.65	84
	Feb.	48	1.44	69
	Mar.	53	1.42	75
	Apr.	102	.97	99
	May	758	.32	242
	June	694	.33	229
-1944	July	230	.69	159
	Aug.	51	1.94	99
	Sept.	45	2.44	110
	Oct.	58	2.31	134
	Nov.	71	1.86	132
	Dec.	64	1.73	111
	Total	2,225	.69	1,543
	Jan.	55	1.58	87
	Feb.	47	1.62	76
	Mar.	52	1.48	77
	Apr.	91	1.00	91
	May	628	.35	220
	June	407	.46	187
-1945	July	163	.85	139
	Aug.	122	1.22	149
	Sept.	46	2.39	110
	Oct.	76	2.00	152
	Nov.	73	1.63	119
	Dec.	58	1.59	92
	Total	1,818	.82	1,499
	Jan.	58	1.55	90
	Feb.	48	1.44	69
	Mar.	58	1.28	74
	Apr.	182	.59	108
	May	229	.59	135
	June	321	.52	167
-1946	July	64	1.62	104
	Aug.	56	2.16	121
	Sept.	54	2.31	125
	Oct.	69	2.06	142
	Nov.	67	1.70	114
	Dec.	56	1.55	87
	Total	1,262	1.06	1,336
	Jan.	45	1.67	75
	Feb.	47	1.49	70
	Mar.	55	1.27	70
	Apr.	96	.82	79
	May	455	.39	177
	June	502	.46	231
-1947	July	242	.64	155
	Aug.	120	1.50	180
	Sept.	96	1.63	156
	Oct.	114	1.60	183
	Nov.	96	1.35	130
	Dec.	70	1.41	99
	Total	1,938	.83	1,605
	Jan.	58	1.38	80
	Feb.	65	1.43	93
	Mar.	76	1.38	105
	Apr.	324	.51	165
	May	835	.30	251
	June	546	.40	218
-1948	July	141	.92	129
	Aug.	71	1.84	131
	Sept.	48	2.25	108
	Oct.	57	2.09	119
	Nov.	70	1.84	129
	Dec.	70	1.64	115
	Total	2,361	.70	1,643
	Jan.	51	1.49	76
	Feb.	52	1.48	77
	Mar.	69	1.42	98
	Apr.	236	.57	134
	May	481	.38	183
	June	651	.42	273
-1949	July	265	.65	172
	Aug.	65	1.80	117
	Sept.	53	2.15	114
	Oct.	70	2.09	146
	Nov.	74	1.58	117
	Dec.	54	1.74	94
	Total	2,121	.76	1,601
	Jan.	54	1.57	85
	Feb.	57	2.00	114
	Mar.	60	1.33	80
	Apr.	219	.50	110
	May	309	.45	139
	June	319	.50	160
-1950	July	88	1.43	126
	Aug.	37	2.16	80
	Sept.	46	2.61	120
	Oct.	37	2.65	98
	Nov.	49	2.12	104
	Dec.	60	1.73	104
	Total	1,335	.99	1,32[illegible]
	Jan.	47	1.64	77
	Feb.	46	1.59	73
	Mar.	55	1.27	70
	Apr.	62	.97	60
	May	265	.51	135
	June	323	.52	168
-1951	July	93	1.06	99
	Aug.	53	1.72	91
	Sept.	37	2.30	85
	Oct.	49	2.41	118
	Nov.	60	1.88	113
	Dec.	46	1.65	76
	Total	1,136	1.03	1,165
	Jan.	53	1.53	81
	Feb.	47	1.48	70
	Mar.	53	1.41	75
	Apr.	342	.46	157
	May	818	.33	270
	June	759	.35	266
-1952	July	200	.79	158
	Aug.	121	1.54	187
	Sept.	76	1.86	141
	Oct.	67	1.90	127
	Nov.	64	2.00	128
	Dec.	72	1.68	121
	Total	2,672	.67	1,781
	Jan.	65	1.51	98
	Feb.	50	1.48	74
	Mar.	61	1.26	77
	Apr.	86	1.01	87
	May	230	.57	131
	June	437	.43	188
-1953	July	86	1.13	97
	Aug.	67	1.75	117
	Sept.	46	2.28	105
	Oct.	58	2.40	139
	Nov.	74	1.78	132
	Dec.	52	1.83	95
	Total	1,312	1.02	1,340
	Jan.	49	1.75	86
	Feb.	45	1.58	71
	Mar.	45	1.49	67
	Apr.	70	.84	59
	May	110	.85	93
	June	39	1.92	75
-1954	July	40	2.10	84
	Aug.	31	2.64	82
	Sept.	52	2.50	130
	Oct.	64	1.94	124
	Nov.	51	1.92	98
	Dec.	49	1.90	93
	Total	645	1.65	1,062
	Jan.	46	1.70	78
	Feb.	40	1.67	67
	Mar.	59	1.47	87
	Apr.	108	.74	80
	May	262	.52	136
	June	219	.63	138
-1955	July	46	1.74	80
	Aug.	52	1.86	97
	Sept.	36	2.48	89
	Oct.	38	2.47	94
	Nov.	54	2.08	112
	Dec.	57	1.65	94
	Total	1,017	1.13	1,152
	Jan.	50	1.64	82
	Feb.	44	1.59	70
	Mar.	56	1.30	73
	Apr.	142	.60	85
	May	324	.45	146
	June	262	.53	139
-1956	July	37	1.92	71
	Aug.	29	2.07	60
	Sept.	20	3.15	63
	Oct.	35	2.94	103
	Nov.	55	1.95	107
	Dec.	47	1.87	88
	Total	1,101	.99	1,087
	Jan.	52	1.73	90
	Feb.	55	1.69	93
	Mar.	56	1.36	76
	Apr.	136	.67	91
	May	554	.44	244
	June	1,168	.32	374
-195	July	719	.39	281
	Aug.	224	.83	186
	Sept.	108	1.47	159
	Oct.	106	1.92	204
	Nov.	111	1.33	148
	Dec.	92	1.26	116
	Total	3,381	.61	2,062
	Jan.	66	1.40	92
	Feb.	70	1.50	105
	Mar.	82	1.24	102
	Apr.	254	.57	145
	May	873	.32	279
	June	570	.42	239
-195	July	65	1.52	99
	Aug.	43	1.74	75
	Sept.	51	2.31	118
	Oct.	52	2.42	126
	Nov.	71	1.82	129
	Dec.	65	1.60	104
	Total	2,262	.71	1,613

To obtain mg/l multiply T/AF by 735.

Table 8
Colorado River Basin
Historical Flow and Quality of Water Data
Gunnison River near Grand Junction, Colorado
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	57	1.58	90
	Feb.	50	1.51	75
	Mar.	52	1.34	70
	Apr.	55	1.10	61
	May	167	.75	125
	June	256	.66	169
-1959	July	34	2.39	81
	Aug.	51	2.01	103
	Sept.	41	2.46	101
	Oct.	96	1.45	139
	Nov.	72	1.39	100
	Dec.	50	1.54	77
	Total	981	1.21	1,191
	Jan.	49	1.46	72
	Feb.	41	1.48	61
	Mar.	87	1.26	110
	Apr.	270	.45	122
	May	259	.45	117
	June	336	.46	155
-1960	July	58	1.33	77
	Aug.	34	2.08	71
	Sept.	38	2.22	84
	Oct.	51	2.34	119
	Nov.	58	1.69	98
	Dec.	51	1.59	81
	Total	1,332	.88	1,167
	Jan.	41	1.65	68
	Feb.	40	1.55	62
	Mar.	55	1.29	71
	Apr.	67	1.05	70
	May	266	.50	133
	June	209	.62	130
-1961	July	34	2.09	71
	Aug.	44	2.07	91
	Sept.	100	1.66	166
	Oct.	107	1.20	128
	Nov.	86	1.20	103
	Dec.	57	1.37	78
	Total	1,106	1.06	1,171
	Jan.	52	1.37	71
	Feb.	58	1.35	78
	Mar.	53	1.22	65
	Apr.	395	.37	146
	May	574	.32	184
	June	477	.37	176
-1962	July	219	.67	147
	Aug.	52	1.72	89
	Sept.	63	1.97	124
	Oct.	70	1.84	129
	Nov.	68	1.62	110
	Dec.	54	1.70	92
	Total	2,135	.66	1,411
	Jan.	48	1.66	80
	Feb.	70	1.51	105
	Mar.	82	1.11	91
	Apr.	102	.72	73
	May	188	.53	100
	June	92	1.02	94
-1963	July	37	2.11	78
	Aug.	52	1.99	104
	Sept.	51	2.28	116
	Oct.	55	2.52	139
	Nov.	66	1.70	112
	Dec.	49	1.69	83
	Total	892	1.32	1,176
	Jan.	43	1.58	68
	Feb.	45	1.51	68
	Mar.	43	1.52	65
	Apr.	78	1.00	78
	May	418	.41	171
	June	316	.50	158
-1964	July	83	1.20	100
	Aug.	93	1.61	150
	Sept.	59	1.99	117
	Oct.	53	2.20	117
	Nov.	65	1.85	120
	Dec.	59	1.46	86
	Total	1,355	.96	1,298
	Jan.	55	1.37	75
	Feb.	45	1.28	58
	Mar.	52	1.33	69
	Apr.	228	.52	119
	May	582	.36	210
	June	681	.37	252
-1965	July	472	.47	222
	Aug.	158	.98	155
	Sept.	161	1.29	208
	Oct.	116	1.35	157
	Nov.	63	1.93	122
	Dec.	60	1.58	95
	Total	2,673	.65	1,742
	Jan.	52	1.67	87
	Feb.	37	1.86	69
	Mar.	68	1.30	88
	Apr.	166	.65	108
	May	211	.67	141
	June	125	1.03	129
-1966	July	51	1.75	89
	Aug.	38	2.09	79
	Sept.	58	1.99	115
	Oct.	65	2.03	132
	Nov.	45	2.34	105
	Dec.	55	1.76	97
	Total	971	1.28	1,239
	Jan.	47	1.63	77
	Feb.	42	1.62	68
	Mar.	62	1.16	72
	Apr.	86	.73	63
	May	143	.81	116
	June	152	1.03	157
-1967	July	60	1.78	107
	Aug.	59	1.93	114
	Sept.	70	1.88	132
	Oct.	65	1.88	122
	Nov.	106	1.16	123
	Dec.	165	.73	120
	Total	1,057	1.20	1,271
	Jan.	119	.95	113
	Feb.	96	1.03	99
	Mar.	65	1.20	78
	Apr.	68	.97	66
	May	268	.57	153
	June	258	.56	144
-1968	July	59	1.62	96
	Aug.	107	1.56	167
	Sept.	68	1.86	126
	Oct.	87	1.72	150
	Nov.	133	1.08	144
	Dec.	149	.77	115
	Total	1,477	.98	1,451

To obtain mg/l multiply T/AF by 735.

Table 8
Colorado River Basin
Historical Flow and Quality of Water Data
Gunnison River near Grand Junction, Colorado
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	2,493	.83	611	2,072
1942	2,674	.77	565	2,057
1943	1,784	.88	649	1,576
1944	2,225	.69	510	1,543
1945	1,818	.82	606	1,499
1946	1,262	1.06	778	1,336
1947	1,938	.83	609	1,605
1948	2,361	.70	511	1,643
1949	2,121	.76	555	1,601
1950	1,335	.99	727	1,320
1951	1,136	1.03	754	1,165
1952	2,672	.67	490	1,781
1953	1,312	1.02	751	1,340
1954	645	1.65	1,210	1,062
1955	1,017	1.13	833	1,152
1956	1,101	.99	726	1,087
1957	3,381	.61	448	2,062
1958	2,262	.71	524	1,613
1959	981	1.21	892	1,191
1960	1,332	.88	644	1,167
1961	1,106	1.06	778	1,171
1962	2,135	.66	486	1,411
1963	892	1.32	969	1,176
1964	1,355	.96	704	1,298
1965	2,673	.65	479	1,742
1966	971	1.28	938	1,239
1967	1,057	1.20	884	1,271
1968	1,477	.98	722	1,451
Total	47,516			40,631
Average	1,697	.86	628	1,451

Sampled quality record entire period.
Measured flow record entire period.

Table 9
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Cisco, Utah
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	139	1.86	259
	Feb.	153	1.78	272
	Mar.	207	1.64	339
	Apr.	445	1.00	445
	May	2,355	.42	989
	June	1,582	.46	728
- 1941	July	579	.73	423
	Aug.	251	1.67	419
	Sept.	237	1.81	429
	Oct.	579	1.10	637
	Nov.	311	1.18	367
	Dec.	229	1.51	346
	Total	7,067	.80	5,653
	Jan.	181	1.67	302
	Feb.	165	1.73	285
	Mar.	228	1.52	347
	Apr.	1,344	.61	820
	May	1,809	.45	814
	June	1,961	.37	725
- 1942	July	579	.78	451
	Aug.	185	1.84	340
	Sept.	134	2.46	329
	Oct.	162	2.33	378
	Nov.	186	1.99	370
	Dec.	164	1.96	322
	Total	7,098	.77	5,483
	Jan.	153	1.90	291
	Feb.	146	1.85	270
	Mar.	174	1.77	308
	Apr.	709	.64	454
	May	996	.46	458
	June	1,365	.38	518
- 1943	July	502	.78	392
	Aug.	368	1.26	463
	Sept.	212	1.85	392
	Oct.	184	1.84	339
	Nov.	215	1.47	317
	Dec.	190	1.56	296
	Total	5,214	.86	4,498
	Jan.	140	1.77	248
	Feb.	152	1.56	237
	Mar.	166	1.51	251
	Apr.	304	1.09	331
	May	1,784	.41	732
	June	1,843	.35	645
- 1944	July	677	.61	413
	Aug.	149	1.62	241
	Sept.	99	2.54	252
	Oct.	159	2.18	347
	Nov.	196	1.78	348
	Dec.	171	1.70	291
	Total	5,840	.74	4,336
	Jan.	149	1.73	258
	Feb.	151	1.74	263
	Mar.	178	1.56	277
	Apr.	328	.88	289
	May	1,495	.36	538
	June	1,311	.37	485
- 1945	July	676	.67	453
	Aug.	446	1.01	451
	Sept.	146	1.85	270
	Oct.	217	1.75	380
	Nov.	224	1.41	316
	Dec.	183	1.26	230
	Total	5,504	.76	4,210
	Jan.	174	1.37	239
	Feb.	155	1.27	197
	Mar.	191	1.24	236
	Apr.	525	.61	320
	May	726	.49	356
	June	1,027	.42	432
- 1946	July	309	.98	303
	Aug.	196	1.66	325
	Sept.	135	2.10	283
	Oct.	206	1.85	382
	Nov.	206	1.56	322
	Dec.	208	1.37	285
	Total	4,058	.91	3,680

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	145	1.58	229
	Feb.	150	1.44	216
	Mar.	189	1.39	263
	Apr.	316	.85	268
	May	1,423	.40	569
	June	1,594	.39	621
- 1947	July	985	.47	463
	Aug.	369	1.21	447
	Sept.	259	1.44	373
	Oct.	328	1.47	483
	Nov.	277	1.24	343
	Dec.	223	1.40	312
	Total	6,258	.73	4,587
	Jan.	191	1.34	256
	Feb.	210	1.33	280
	Mar.	245	1.36	333
	Apr.	830	.64	531
	May	1,959	.36	705
	June	1,499	.39	585
- 1948	July	446	.86	384
	Aug.	225	1.52	342
	Sept.	121	1.88	228
	Oct.	175	1.96	343
	Nov.	204	1.67	341
	Dec.	186	1.66	308
	Total	6,291	.74	4,636
	Jan.	188	1.54	289
	Feb.	187	1.35	253
	Mar.	243	1.40	340
	Apr.	615	.67	412
	May	1,289	.41	529
	June	1,910	.37	707
- 1949	July	908	.55	499
	Aug.	224	1.58	354
	Sept.	158	2.08	328
	Oct.	226	1.83	414
	Nov.	210	1.71	359
	Dec.	180	1.66	299
	Total	6,338	.75	4,783
	Jan.	199	1.52	302
	Feb.	201	1.44	289
	Mar.	209	1.31	274
	Apr.	541	.61	330
	May	764	.51	389
	June	1,113	.42	467
- 1950	July	347	1.03	357
	Aug.	109	2.02	220
	Sept.	138	2.12	292
	Oct.	125	2.35	294
	Nov.	161	1.96	316
	Dec.	167	1.75	293
	Total	4,074	.94	3,823
	Jan.	153	1.69	258
	Feb.	151	1.51	228
	Mar.	161	1.46	236
	Apr.	173	1.21	209
	May	758	.54	409
	June	1,173	.43	505
- 1951	July	529	.68	360
	Aug.	238	1.47	350
	Sept.	131	2.06	270
	Oct.	169	1.99	336
	Nov.	178	1.74	310
	Dec.	172	1.67	287
	Total	3,986	.94	3,758
	Jan.	191	1.59	303
	Feb.	155	1.65	256
	Mar.	194	1.48	287
	Apr.	969	.53	514
	May	2,152	.35	753
	June	2,314	.33	764
- 1952	July	641	.72	462
	Aug.	358	1.18	422
	Sept.	213	1.58	337
	Oct.	166	1.92	318
	Nov.	177	1.89	334
	Dec.	188	1.66	313
	Total	7,718	.66	5,063

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	185	1.65	306
	Feb.	143	1.63	233
	Mar.	187	1.52	284
	Apr.	250	1.00	250
	May	606	.60	364
	June	1,399	.41	574
- 1953	July	353	.95	335
	Aug.	256	1.23	315
	Sept.	128	2.22	284
	Oct.	177	1.89	334
	Nov.	207	1.77	366
	Dec.	171	1.75	299
	Total	4,062	.97	3,944
	Jan.	177	1.76	312
	Feb.	143	1.65	236
	Mar.	161	1.46	235
	Apr.	221	.98	217
	May	436	.74	323
	June	217	1.17	254
- 1954	July	150	1.69	253
	Aug.	98	2.30	225
	Sept.	171	2.09	358
	Oct.	215	1.59	342
	Nov.	164	1.70	278
	Dec.	140	1.90	266
	Total	2,293	1.44	3,299
	Jan.	134	1.84	247
	Feb.	121	1.78	215
	Mar.	198	1.33	263
	Apr.	320	.82	262
	May	752	.50	376
	June	689	.55	379
- 1955	July	214	1.21	259
	Aug.	185	1.66	307
	Sept.	108	2.16	233
	Oct.	119	2.19	261
	Nov.	169	1.89	319
	Dec.	176	1.70	299
	Total	3,185	1.07	3,420
	Jan.	155	1.69	262
	Feb.	141	1.70	239
	Mar.	187	1.50	281
	Apr.	356	.72	256
	May	1,005	.45	452
	June	924	.44	406
- 1956	July	172	1.47	253
	Aug.	119	1.97	234
	Sept.	81	2.38	193
	Oct.	121	2.22	269
	Nov.	165	1.87	308
	Dec.	142	1.94	275
	Total	3,568	.96	3,428
	Jan.	164	1.80	296
	Feb.	168	1.55	260
	Mar.	167	1.56	260
	Apr.	398	.86	342
	May	1,375	.44	605
	June	2,859	.29	829
- 1957	July	1,952	.37	722
	Aug.	661	.83	549
	Sept.	314	1.21	380
	Oct.	292	1.78	520
	Nov.	299	1.44	431
	Dec.	239	1.71	408
	Total	8,888	.63	5,602
	Jan.	200	1.52	304
	Feb.	225	1.34	302
	Mar.	254	1.29	328
	Apr.	756	.53	401
	May	2,032	.31	630
	June	1,560	.40	624
- 1958	July	234	1.22	285
	Aug.	109	2.17	236
	Sept.	153	2.14	328
	Oct.	155	1.99	308
	Nov.	190	1.66	315
	Dec.	176	1.63	287
	Total	6,044	.72	4,348

To obtain mg/l multiply T/AF by 735.

Table 9

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Cisco, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	168	1.71	287
	Feb.	153	1.41	216
	Mar.	150	1.60	240
	Apr.	163	1.39	227
	May	535	.65	348
	June	924	.50	462
- 1959	July	214	1.15	246
	Aug.	160	1.91	306
	Sept.	124	2.14	265
	Oct.	250	1.43	358
	Nov.	210	1.31	275
	Dec.	163	1.54	251
	Total	3,214	1.08	3,481
	Jan.	164	1.51	248
	Feb.	143	1.51	216
	Mar.	273	1.22	333
	Apr.	629	.51	321
	May	758	.49	371
	June	1,068	.42	448
- 1960	July	250	1.04	260
	Aug.	105	1.96	206
	Sept.	117	2.16	253
	Oct.	153	1.94	297
	Nov.	177	1.67	296
	Dec.	165	1.48	244
	Total	4,002	.87	3,493
	Jan.	156	1.43	223
	Feb.	140	1.52	213
	Mar.	162	1.44	233
	Apr.	206	1.14	235
	May	677	.57	386
	June	664	.51	339
- 1961	July	130	1.62	211
	Aug.	138	2.01	277
	Sept.	316	1.49	471
	Oct.	357	1.07	382
	Nov.	252	1.23	310
	Dec.	197	1.40	276
	Total	3,395	1.05	3,556
	Jan.	182	1.29	235
	Feb.	261	1.12	292
	Mar.	246	1.05	258
	Apr.	1,054	.44	464
	May	1,603	.38	609
	June	1,400	.38	532
- 1962	July	765	.58	444
	Aug.	206	1.42	293
	Sept.	173	1.99	344
	Oct.	263	1.43	376
	Nov.	243	1.31	318
	Dec.	180	1.77	319
	Total	6,576	.68	4,484
	Jan.	163	1.52	248
	Feb.	193	1.51	292
	Mar.	219	1.30	285
	Apr.	245	.91	223
	May	517	.62	320
	June	332	.93	309
- 1963	July	114	1.94	221
	Aug.	168	1.94	326
	Sept.	183	1.80	329
	Oct.	134	2.14	287
	Nov.	179	1.62	290
	Dec.	138	1.84	254
	Total	2,585	1.31	3,384
	Jan.	132	1.85	244
	Feb.	121	1.79	217
	Mar.	128	1.87	239
	Apr.	214	1.11	238
	May	861	.50	430
	June	780	.50	390
[illegible]	July	276	1.07	295
	Aug.	241	1.51	364
	Sept.	153	1.88	288
	Oct.	164	1.93	317
	Nov.	182	1.81	329
	Dec.	181	1.59	288
	Total	3,433	1.06	3,639

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	162	1.55	251
	Feb.	140	1.63	228
	Mar.	154	1.59	245
	Apr.	562	.68	382
	May	1,272	.39	496
	June	1,654	.38	629
- 1965	July	1,116	.52	580
	Aug.	447	.94	420
	Sept.	369	1.21	446
	Oct.	360	1.32	475
	Nov.	249	1.65	411
	Dec.	237	1.39	329
	Total	6,722	.73	4,892
	Jan.	200	1.38	276
	Feb.	169	1.34	226
	Mar.	278	.96	267
	Apr.	438	.61	267
	May	697	.53	369
	June	429	.83	356
- 1966	July	185	1.50	278
	Aug.	120	1.89	227
	Sept.	145	2.01	291
	Oct.	175	1.87	327
	Nov.	153	1.89	289
	Dec.	174	1.71	298
	Total	3,163	1.10	3,471
	Jan.	146	1.77	258
	Feb.	136	1.71	233
	Mar.	185	1.30	240
	Apr.	198	1.31	259
	May	462	.76	351
	June	713	.65	463
- 1967	July	327	1.09	356
	Aug.	175	1.76	308
	Sept.	178	1.77	315
	Oct.	174	1.39	242
	Nov.	211	1.39	293
	Dec.	241	1.18	284
	Total	3,146	1.14	3,602
	Jan.	205	1.18	242
	Feb.	193	1.20	232
	Mar.	171	1.41	241
	Apr.	230	.99	228
	May	667	.60	400
	June	1,171	.44	515
- 1968	July	306	1.08	330
	Aug.	365	1.23	449
	Sept.	159	1.72	273
	Oct.	213	1.63	347
	Nov.	257	1.28	329
	Dec.	248	1.14	283
	Total	4,185	.92	3,869
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
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	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
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	Total			
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	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 9
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Cisco, Utah
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	7,067	.80	588	5,653
1942	7,098	.77	568	5,483
1943	5,214	.86	634	4,498
1944	5,840	.74	546	4,336
1945	5,504	.76	562	4,210
1946	4,058	.91	667	3,680
1947	6,258	.73	539	4,587
1948	6,291	.74	542	4,636
1949	6,338	.75	555	4,783
1950	4,074	.94	690	3,823
1951	3,986	.94	693	3,758
1952	7,718	.66	482	5,063
1953	4,062	.97	714	3,944
1954	2,293	1.44	1,060	3,299
1955	3,185	1.07	789	3,420
1956	3,568	.96	706	3,428
1957	8,888	.63	463	5,602
1958	6,044	.72	529	4,348
1959	3,214	1.08	796	3,481
1960	4,002	.87	642	3,493
1961	3,395	1.05	770	3,556
1962	6,576	.68	501	4,484
1963	2,585	1.31	962	3,384
1964	3,433	1.06	779	3,639
1965	6,722	.73	535	4,892
1966	3,163	1.10	807	3,471
1967	3,146	1.14	842	3,602
1968	4,185	.92	680	3,869
Total	137,907			116,422
Average	4,925	.84	620	4,158

Sampled quality record entire period.
Measured flow record entire period.

Table 10

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Archuleta, New Mexico

Units – 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	22	0.41	9
	Feb.	46	.35	16
	Mar.	98	.38	37
	Apr.	251	.21	53
	May	709	.16	112
	June	560	.12	68
- 1941	July	324	.14	46
	Aug.	84	.19	16
	Sept.	68	.24	16
	Oct.	273	.12	33
	Nov.	87	.17	15
	Dec.	52	.21	11
	Total	2,574	.17	430
	Jan.	45	.33	15
	Feb.	48	.25	12
	Mar.	54	.42	23
	Apr.	383	.21	82
	May	320	.15	48
	June	310	.12	38
- 1942	July	76	.18	14
	Aug.	41	.22	9
	Sept.	23	.25	7
	Oct.	23	.26	6
	Nov.	22	.27	6
	Dec.	16	.38	6
	Total	1,366	.19	266
	Jan.	16	.44	7
	Feb.	26	.35	9
	Mar.	55	.38	21
	Apr.	198	.19	37
	May	184	.16	30
	June	134	.15	20
- 1943	July	51	.24	12
	Aug.	48	.21	10
	Sept.	28	.25	7
	Oct.	35	.20	7
	Nov.	24	.29	7
	Dec.	19	.32	6
	Total	818	.21	173
	Jan.	16	.38	6
	Feb.	19	.32	6
	Mar.	34	.47	16
	Apr.	131	.21	27
	May	371	.16	61
	June	382	.13	49
- 1944	July	134	.16	22
	Aug.	45	.20	9
	Sept.	43	.23	10
	Oct.	41	.22	9
	Nov.	21	.29	6
	Dec.	14	.43	6
	Total	1,251	.18	227
	Jan.	14	.43	6
	Feb.	22	.45	10
	Mar.	35	.49	17
	Apr.	143	.20	28
	May	278	.16	44
	June	209	.13	28
- 1945	July	68	.21	14
	Aug.	40	.22	9
	Sept.	21	.24	5
	Oct.	30	.37	11
	Nov.	19	.37	7
	Dec.	12	.50	6
	Total	891	.21	185
	Jan.	14	.43	6
	Feb.	17	.47	8
	Mar.	22	.50	11
	Apr.	66	.23	15
	May	73	.18	13
	June	87	.18	16
- 1946	July	27	.33	9
	Aug.	40	.35	14
	Sept.	29	.31	9
	Oct.	36	.31	11
	Nov.	26	.35	9
	Dec.	19	.32	6
	Total	456	.28	127
	Jan.	15	0.40	6
	Feb.	24	.38	9
	Mar.	32	.34	11
	Apr.	50	.24	12
	May	186	.17	32
	June	140	.13	18
- 1947	July	43	.28	12
	Aug.	73	.30	22
	Sept.	56	.23	13
	Oct.	77	.21	16
	Nov.	37	.22	8
	Dec.	27	.26	7
	Total	760	.22	166
	Jan.	27	.26	7
	Feb.	39	.33	13
	Mar.	43	.35	15
	Apr.	246	.20	49
	May	306	.14	43
	June	338	.12	40
- 1948	July	79	.16	13
	Aug.	49	.24	12
	Sept.	22	.32	7
	Oct.	23	.35	8
	Nov.	18	.39	7
	Dec.	13	.46	6
	Total	1,203	.18	220
	Jan.	16	.44	7
	Feb.	25	.36	9
	Mar.	73	.37	27
	Apr.	228	.24	55
	May	318	.15	48
	June	406	.13	53
- 1949	July	199	.15	30
	Aug.	57	.24	14
	Sept.	33	.27	9
	Oct.	30	.30	9
	Nov.	21	.38	8
	Dec.	14	.50	7
	Total	1,420	.19	276
	Jan.	16	.37	6
	Feb.	29	.41	12
	Mar.	31	.42	13
	Apr.	116	.19	22
	May	126	.15	19
	June	112	.16	18
- 1950	July	44	.27	12
	Aug.	20	.35	7
	Sept.	24	.38	9
	Oct.	20	.35	7
	Nov.	14	.50	7
	Dec.	12	.50	6
	Total	564	.24	138
	Jan.	10	.50	5
	Feb.	11	.45	5
	Mar.	20	.45	9
	Apr.	35	.29	10
	May	117	.18	21
	June	94	.17	16
- 1951	July	21	.38	8
	Aug.	33	.36	12
	Sept.	22	.36	8
	Oct.	17	.47	8
	Nov.	15	.47	7
	Dec.	18	.44	8
	Total	413	.28	117
	Jan.	19	.53	10
	Feb.	19	.53	10
	Mar.	47	.49	23
	Apr.	326	.26	85
	May	396	.16	63
	June	454	.13	59
- 1952	July	136	.18	24
	Aug.	66	.26	17
	Sept.	33	.27	9
	Oct.	22	.32	7
	Nov.	16	.44	7
	Dec.	18	.39	7
	Total	1,552	.21	321
	Jan.	18	0.39	7
	Feb.	18	.39	7
	Mar.	37	.41	15
	Apr.	75	.24	18
	May	117	.19	22
	June	148	.15	22
- 1953	July	41	.32	13
	Aug.	33	.33	11
	Sept.	16	.44	7
	Oct.	23	.43	10
	Nov.	23	.43	10
	Dec.	14	.50	7
	Total	563	.26	149
	Jan.	11	.45	5
	Feb.	21	.48	10
	Mar.	28	.46	13
	Apr.	90	.21	19
	May	143	.18	26
	June	67	.19	13
- 1954	July	37	.41	15
	Aug.	45	.29	13
	Sept.	30	.43	13
	Oct.	42	.24	10
	Nov.	18	.39	7
	Dec.	13	.46	6
	Total	545	.28	150
	Jan.	12	.42	5
	Feb.	13	.31	4
	Mar.	27	.37	10
	Apr.	45	.24	11
	May	132	.18	24
	June	119	.16	19
- 1955	July	42	.29	12
	Aug.	67	.28	19
	Sept.	28	.29	8
	Oct.	20	.30	6
	Nov.	17	.35	6
	Dec.	15	.40	6
	Total	537	.24	130
	Jan.	16	.38	6
	Feb.	15	.40	6
	Mar.	48	.33	16
	Apr.	79	.20	16
	May	173	.14	24
	June	117	.15	18
- 1956	July	25	.32	8
	Aug.	23	.35	8
	Sept.	11	.36	4
	Oct.	12	.42	5
	Nov.	11	.45	5
	Dec.	9	.44	4
	Total	539	.22	120
	Jan.	13	.46	6
	Feb.	30	.47	14
	Mar.	46	.43	20
	Apr.	120	.28	34
	May	222	.19	42
	June	480	.13	62
- 1957	July	326	.16	52
	Aug.	164	.22	36
	Sept.	67	.19	13
	Oct.	67	.30	20
	Nov.	68	.26	18
	Dec.	44	.30	13
	Total	1,647	.20	330
	Jan.	22	.36	8
	Feb.	51	.43	22
	Mar.	77	.42	32
	Apr.	279	.30	84
	May	460	.17	78
	June	270	.13	35
- 1958	July	42	.26	11
	Aug.	35	.31	11
	Sept.	40	.30	12
	Oct.	25	.36	9
	Nov.	17	.41	7
	Dec.	14	.43	6
	Total	1,332	.24	315

To obtain mg/l multiply T/AF by 735.

Table 10

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Archuleta, New Mexico

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	11	0.46	5
	Feb.	14	.44	6
	Mar.	18	.42	8
	Apr.	37	.30	11
	May	87	.18	16
	June	84	.16	13
- 1959	July	18	.32	6
	Aug.	34	.33	11
	Sept.	15	.34	5
	Oct.	60	.30	18
	Nov.	39	.30	12
	Dec.	19	.37	7
	Total	436	.27	118
	Jan.	14	.43	6
	Feb.	16	.42	7
	Mar.	175	.34	60
	Apr.	240	.19	46
	May	193	.17	33
	June	232	.13	30
- 1960	July	55	.23	13
	Aug.	25	.29	7
	Sept.	23	.31	7
	Oct.	26	.37	10
	Nov.	16	.42	7
	Dec.	14	.54	7
	Total	1,029	.23	233
	Jan.	12	.45	5
	Feb.	16	.43	7
	Mar.	43	.44	19
	Apr.	113	.26	29
	May	192	.15	29
	June	122	.16	19
- 1961	July	38	.28	11
	Aug.	52	.28	15
	Sept.	58	.25	15
	Oct.	52	.24	12
	Nov.	34	.28	10
	Dec.	18	.31	6
	Total	750	.24	177
	Jan.	15	.37	6
	Feb.	42	.38	16
	Mar.	51	.38	20
	Apr.	242	.20	48
	May	228	.14	32
	June	165	.14	23
- 1962	July	39	.19	7
	Aug.	29	.25	7
	Sept.	19	.25	5
	Oct.	18	.31	6
	Nov.	14	.33	5
	Dec.	10	.37	4
	Total	872	.21	179
	Jan.	7	.39	3
	Feb.	8	.43	4
	Mar.	15	.39	6
	Apr.	31	.38	12
	May	19	.26	5
	June	19	.19	4
- 1963	July	20	.18	4
	Aug.	21	.19	4
	Sept.	20	.20	4
	Oct.	24	.23	6
	Nov.	24	.24	6
	Dec.	24	.28	7
	Total	232	.28	65
	Jan.	17	.32	6
	Feb.	13	.31	4
	Mar.	13	.32	4
	Apr.	15	.32	5
	May	34	.31	10
	June	82	.28	23
- 1964	July	108	.25	27
	Aug.	48	.23	11
	Sept.	26	.22	6
	Oct.	28	.23	6
	Nov.	21	.27	6
	Dec.	32	.28	9
	Total	437	.27	117
	Jan.	90	0.29	26
	Feb.	92	.30	28
	Mar.	52	.36	19
	Apr.	85	.35	30
	May	138	.29	40
	June	215	.20	43
- 1965	July	102	.18	18
	Aug.	136	.17	23
	Sept.	112	.17	19
	Oct.	131	.13	17
	Nov.	180	.16	29
	Dec.	178	.18	32
	Total	1,511	.21	324
	Jan.	168	.21	35
	Feb.	94	.26	24
	Mar.	114	.29	33
	Apr.	181	.28	51
	May	130	.26	34
	June	27	.22	6
- 1966	July	28	.17	5
	Aug.	29	.18	5
	Sept.	27	.17	5
	Oct.	91	.18	16
	Nov.	47	.20	9
	Dec.	25	.24	6
	Total	961	.24	229
	Jan.	25	.26	6
	Feb.	45	.26	12
	Mar.	70	.26	18
	Apr.	23	.27	6
	May	17	.31	5
	June	18	.35	6
- 1967	July	20	.34	7
	Aug.	62	.29	18
	Sept.	59	.26	15
	Oct.	21	.23	5
	Nov.	21	.26	5
	Dec.	21	.28	6
	Total	402	.27	109
	Jan.	19	.29	6
	Feb.	20	.26	5
	Mar.	18	.29	5
	Apr.	60	.27	16
	May	49	.26	13
	June	28	.26	7
- 1968	July	30	.28	8
	Aug.	39	.27	11
	Sept.	47	.25	12
	Oct.	35	.25	9
	Nov.	23	.24	6
	Dec.	24	.23	6
	Total	392	.27	104
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
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	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
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	Nov.			
	Dec.			
	Total			
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	Oct.			
	Nov.			
	Dec.			
	Total			
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	Feb.			
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	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 10
Colorado River Basin
Historical Flow and Quality of Water Data
San Juan River near Archuleta, New Mexico
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	2,574	0.17	123	430
1942	1,366	.19	143	266
1943	818	.21	155	173
1944	1,251	.18	133	227
1945	891	.21	153	185
1946	456	.28	205	127
1947	760	.22	161	166
1948	1,203	.18	134	220
1949	1,420	.19	142	276
1950	564	.24	180	138
1951	413	.28	208	117
1952	1,552	.21	152	321
1953	563	.26	195	149
1954	545	.28	202	150
1955	537	.24	178	130
1956	539	.22	164	120
1957	1,647	.20	147	330
1958	1,332	.24	174	315
1959	436	.27	199	118
1960	1,029	.23	166	233
1961	750	.24	173	177
1962	872	.21	151	179
1963	232	.28	206	65
1964	437	.27	197	117
1965	1,511	.21	158	324
1966	961	.24	175	229
1967	402	.27	199	109
1968	392	.27	195	104
Total	25,453			5,495
Average	909	.22	158	196

Sampled quality record, October 1945 to December 1968; remainder by correlation.

Measured flow record entire period.

Adjusted quality and flow record for station near Blanco, October 1945 to November 1954.

Table II
Colorado River Basin
Historical Flow and Quality of Water Data
San Juan River near Bluff, Utah
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	78	1.01	79
	Feb.	127	.98	124
	Mar.	211	.78	165
	Apr.	392	.62	243
	May	1,323	.50	662
	June	915	.30	275
-1941	July	526	.30	158
	Aug.	174	.70	122
	Sept.	202	.87	176
	Oct.	655	.64	419
	Nov.	191	.61	117
	Dec.	105	.81	85
	Total	4,899	.54	2,625
	Jan.	81	.93	75
	Feb.	68	.93	63
	Mar.	126	.95	120
	Apr.	602	.51	307
	May	479	.38	182
	June	533	.26	139
-1942	July	150	.48	72
	Aug.	51	.82	42
	Sept.	38	1.00	38
	Oct.	37	1.22	45
	Nov.	39	1.23	48
	Dec.	43	1.26	54
	Total	2,247	.53	1,185
	Jan.	43	1.26	54
	Feb.	49	1.18	58
	Mar.	95	1.09	104
	Apr.	294	.47	138
	May	332	.39	129
	June	254	.38	96
-1943	July	106	.57	60
	Aug.	91	1.01	92
	Sept.	62	.90	56
	Oct.	58	1.00	58
	Nov.	59	.97	57
	Dec.	51	1.12	57
	Total	1,494	.64	959
	Jan.	37	1.16	43
	Feb.	49	1.14	56
	Mar.	76	1.06	81
	Apr.	204	.62	126
	May	640	.36	230
	June	705	.25	176
-1944	July	283	.35	99
	Aug.	61	.85	52
	Sept.	66	.92	61
	Oct.	75	.91	68
	Nov.	52	1.12	58
	Dec.	43	1.19	51
	Total	2,291	.48	1,101
	Jan.	41	1.22	50
	Feb.	63	1.13	71
	Mar.	72	1.03	74
	Apr.	196	.61	120
	May	456	.35	160
	June	377	.29	109
-1945	July	128	.50	64
	Aug.	96	1.13	108
	Sept.	21	1.18	25
	Oct.	62	1.10	68
	Nov.	46	1.04	48
	Dec.	30	1.27	38
	Total	1,588	.59	935
	Jan.	37	1.14	42
	Feb.	36	1.19	43
	Mar.	47	1.04	49
	Apr.	95	.66	63
	May	125	.49	61
-1946	June	204	.40	82
	July	63	.86	54
	Aug.	75	1.12	84
	Sept.	44	.93	41
	Oct.	55	.98	54
	Nov.	60	1.02	61
	Dec.	46	1.02	47
	Total	887	.77	681
	Jan.	31	1.13	35
	Feb.	45	1.07	48
	Mar.	51	.90	46
	Apr.	68	.63	43
	May	329	.38	125
	June	276	.30	83
-1947	July	110	.41	45
	Aug.	294	1.01	296
	Sept.	124	.73	91
	Oct.	207	.79	163
	Nov.	77	.73	56
	Dec.	65	.86	56
	Total	1,677	.65	1,087
	Jan.	52	.83	43
	Feb.	79	.84	66
	Mar.	89	.83	74
	Apr.	358	.37	133
	May	519	.27	140
	June	603	.28	169
-1948	July	147	.41	60
	Aug.	86	.78	67
	Sept.	36	1.11	40
	Oct.	75	1.05	79
	Nov.	55	1.07	59
	Dec.	41	1.12	46
	Total	2,140	.46	976
	Jan.	63	1.11	70
	Feb.	74	.99	73
	Mar.	152	.81	123
	Apr.	338	.45	152
	May	503	.31	156
	June	748	.31	232
-1949	July	342	.33	113
	Aug.	90	.66	59
	Sept.	41	1.05	43
	Oct.	56	1.00	56
	Nov.	45	1.07	48
	Dec.	35	1.23	43
	Total	2,487	.47	1,168
	Jan.	41	1.12	46
	Feb.	49	1.08	53
	Mar.	56	.93	52
	Apr.	136	.46	62
	May	169	.40	68
	June	191	.38	73
-1950	July	68	.72	49
	Aug.	15	1.13	17
	Sept.	42	1.14	48
	Oct.	30	1.07	32
	Nov.	25	1.44	36
	Dec.	32	1.34	43
	Total	854	.68	579
	Jan.	30	1.30	39
	Feb.	29	1.41	41
	Mar.	34	1.15	39
	Apr.	34	.85	29
	May	142	.51	72
	June	188	.36	68
-1951	July	30	.80	24
	Aug.	49	1.06	52
	Sept.	45	1.07	48
	Oct.	35	1.23	43
	Nov.	39	1.10	43
	Dec.	36	1.28	46
	Total	691	.79	544
	Jan.	88	1.16	102
	Feb.	40	1.20	48
	Mar.	87	1.03	90
	Apr.	453	.42	190
	May	618	.30	185
-1952	June	769	.24	185
	July	238	.42	100
	Aug.	83	.69	57
	Sept.	56	.93	52
	Oct.	38	1.05	40
	Nov.	41	1.29	53
	Dec.	43	1.26	54
	Total	2,554	.45	1,156
	Jan.	42	1.24	52
	Feb.	36	1.17	42
	Mar.	56	1.02	57
	Apr.	107	.64	68
	May	156	.44	69
	June	267	.27	72
-1953	July	77	.84	65
	Aug.	71	1.15	82
	Sept.	12	1.50	18
	Oct.	54	1.28	69
	Nov.	55	1.13	62
	Dec.	34	1.31	45
	Total	967	.73	701
	Jan.	32	1.34	43
	Feb.	36	1.17	42
	Mar.	48	1.02	49
	Apr.	113	.53	60
	May	218	.39	85
	June	120	.48	58
-1954	July	120	1.03	123
	Aug.	66	.86	57
	Sept.	89	1.19	106
	Oct.	95	.75	71
	Nov.	39	1.05	41
	Dec.	35	1.26	44
	Total	1,011	.77	779
	Jan.	31	1.26	39
	Feb.	34	1.12	38
	Mar.	63	1.00	63
	Apr.	62	.74	46
	May	186	.38	71
	June	208	.32	67
-1955	July	65	.88	57
	Aug.	142	1.07	152
	Sept.	28	.82	23
	Oct.	25	1.00	25
	Nov.	31	1.26	39
	Dec.	35	1.34	47
	Total	910	.73	667
	Jan.	40	1.22	49
	Feb.	34	1.29	44
	Mar.	74	.83	61
	Apr.	107	.50	54
	May	241	.35	84
	June	203	.31	63
-1956	July	31	1.10	34
	Aug.	36	1.33	48
	Sept.	4	1.50	6
	Oct.	13	1.54	20
	Nov.	30	1.23	37
	Dec.	25	1.40	35
	Total	838	.64	535
	Jan.	38	1.26	48
	Feb.	64	1.05	67
	Mar.	71	.97	69
	Apr.	171	.55	94
	May	327	.48	157
	June	787	.28	220
-1957	July	566	.38	215
	Aug.	364	.63	229
	Sept.	142	.68	97
	Oct.	150	.86	129
	Nov.	141	.72	102
	Dec.	88	.81	71
	Total	2,909	.51	1,498
	Jan.	53	1.02	54
	Feb.	119	.92	109
	Mar.	159	.87	139
	Apr.	413	.48	198
	May	743	.26	193
	June	507	.25	126
-1958	July	74	.65	48
	Aug.	43	1.02	43
	Sept.	61	.95	58
	Oct.	47	1.04	49
	Nov.	43	1.23	53
	Dec.	36	1.28	46
	Total	2,298	.49	1,116

To obtain mg/l multiply T/AF by 735.

Table 11

Colorado River Basin

Historical Flow and Quality of Water Data

San Juan River near Bluff, Utah

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	30	1.39	42
	Feb.	31	1.36	42
	Mar.	32	1.27	41
	Apr.	39	.94	37
	May	111	.52	58
	June	156	.39	61
-1959	July	18	.81	15
	Aug.	64	1.13	72
	Sept.	11	1.53	17
	Oct.	92	.86	79
	Nov.	82	.82	67
	Dec.	46	1.02	47
	Total	712	.81	578
	Jan.	37	1.26	47
	Feb.	43	1.09	47
	Mar.	260	.73	190
	Apr.	336	.32	108
	May	285	.34	97
	June	382	.27	103
-1960	July	92	.53	49
	Aug.	18	1.11	20
	Sept.	17	1.24	21
	Oct.	58	1.13	66
	Nov.	39	1.22	48
	Dec.	40	1.27	51
	Total	1,607	.53	847
	Jan.	35	1.33	47
	Feb.	41	1.31	54
	Mar.	66	1.02	67
	Apr.	157	.56	88
	May	285	.32	91
	June	227	.31	70
-1961	July	43	.83	36
	Aug.	87	1.05	91
	Sept.	109	.88	96
	Oct.	98	.77	75
	Nov.	72	.93	67
	Dec.	44	1.22	54
	Total	1,264	.66	836
	Jan.	36	1.24	45
	Feb.	94	.95	89
	Mar.	73	.99	72
	Apr.	315	.37	117
	May	346	.30	104
	June	297	.32	95
-1962	July	88	.59	52
	Aug.	23	1.02	23
	Sept.	26	1.41	37
	Oct.	104	1.32	137
	Nov.	45	1.34	60
	Dec.	33	1.40	46
	Total	1,480	.59	877
	Jan.	25	1.66	42
	Feb.	39	1.44	56
	Mar.	40	1.25	50
	Apr.	64	.78	50
	May	95	.72	68
-1963	June	47	.82	39
	July	15	1.60	24
	Aug.	48	1.57	75
	Sept.	70	1.09	76
	Oct.	41	1.32	54
	Nov.	47	1.10	52
	Dec.	48	1.03	49
	Total	579	1.10	635
	Jan.	44	1.14	50
	Feb.	30	1.27	38
	Mar.	28	1.46	41
	Apr.	30	1.40	42
	May	103	.57	59
	June	121	.58	70
-1964	July	113	.76	86
	Aug.	131	1.07	140
	Sept.	56	1.36	76
	Oct.	37	1.26	47
	Nov.	42	1.43	60
	Dec.	60	1.20	72
	Total	795	.98	781
	Jan.	122	0.77	94
	Feb.	120	.70	84
	Mar.	85	.93	79
	Apr.	165	.62	102
	May	288	.45	130
	June	419	.38	159
-1965	July	295	.45	133
	Aug.	218	.65	142
	Sept.	177	.56	99
	Oct.	190	.60	114
	Nov.	232	.50	116
	Dec.	235	.54	127
	Total	2,546	.54	1,379
	Jan.	198	0.54	107
	Feb.	129	.65	84
	Mar.	199	.68	135
	Apr.	252	.48	121
	May	267	.42	112
	June	127	.56	71
-1966	July	54	1.01	55
	Aug.	44	1.30	57
	Sept.	42	1.25	52
	Oct.	94	.66	62
	Nov.	70	.86	60
	Dec.	72	1.11	80
	Total	1,548	.64	996
	Jan.	58	1.07	62
	Feb.	64	.92	59
	Mar.	79	.71	56
	Apr.	31	1.15	36
	May	78	.76	59
	June	89	.91	81
-1967	July	39	1.35	53
	Aug.	151	1.29	195
	Sept.	94	.96	90
	Oct.	31	1.46	45
	Nov.	38	1.26	48
	Dec.	39	1.20	47
	Total	791	1.05	831
	Jan.	36	1.22	44
	Feb.	54	1.29	70
	Mar.	50	1.25	62
	Apr.	83	.75	62
	May	148	.54	80
	June	240	.37	89
-1968	July	82	.93	76
	Aug.	176	1.04	183
	Sept.	41	1.00	41
	Oct.	56	1.09	61
	Nov.	49	1.18	58
	Dec.	45	1.07	48
	Total	1,060	.82	874
	Jan.			
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	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table II
Colorado River Basin
Historical Flow and Quality of Water Data
San Juan River near Bluff, Utah
(Annual Summary)

Units – 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	4,899	.54	394	2,625
1942	2,247	.53	388	1,185
1943	1,494	.64	472	959
1944	2,291	.48	353	1,101
1945	1,588	.59	433	935
1946	887	.77	564	681
1947	1,677	.65	476	1,087
1948	2,140	.46	335	976
1949	2,487	.47	345	1,168
1950	854	.68	498	579
1951	691	.79	579	544
1952	5,554	.45	333	1,156
1953	967	.73	533	701
1954	1,011	.77	566	779
1955	910	.73	539	667
1956	838	.64	469	535
1957	2,909	.51	378	1,498
1958	2,298	.49	357	1,116
1959	712	.81	597	578
1960	1,607	.53	387	847
1961	1,264	.66	486	836
1962	1,480	.59	436	877
1963	579	1.10	806	635
1964	795	.98	722	781
1965	2,546	.54	398	1,379
1966	1,548	.64	473	996
1967	791	1.05	772	831
1968	1,060	.82	606	874
Total	45,124			26,926
Average	1,612	.60	439	962

Sampled quality record entire period.
Measured flow records entire period.

Table 12
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River at Lees Ferry, Arizona

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)	Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)	Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	348	1.36	474		Jan.	277	1.40	388		Jan.	393	1.36	534
	Feb.	423	1.29	546		Feb.	357	1.29	462		Feb.	365	1.30	475
	Mar.	669	1.12	749		Mar.	654	1.09	713		Mar.	458	1.22	558
	Apr.	1,091	.79	862		Apr.	780	.78	608		Apr.	529	1.07	566
	May	4,974	.45	2,239		May	3,121	.39	1,217		May	1,047	.69	723
	June	4,004	.38	1,522		June	3,275	.40	1,310		June	2,992	.38	1,137
-1941	July	1,666	.51	850	-1947	July	1,926	.43	828	-1953	July	950	.64	608
	Aug.	798	1.16	925		Aug.	1,203	.98	1,179		Aug.	661	1.19	787
	Sept.	608	1.35	821		Sept.	584	1.13	660		Sept.	258	1.59	410
	Oct.	1,797	1.09	1,959		Oct.	818	1.17	958		Oct.	321	1.77	568
	Nov.	903	.94	849		Nov.	585	1.07	626		Nov.	414	1.50	621
	Dec.	576	1.19	685		Dec.	466	1.21	564		Dec.	341	1.46	498
	Total	17,857	.70	12,481		Total	14,046	.68	9,513		Total	8,729	.86	7,486
	Jan.	407	1.34	545		Jan.	406	1.18	479		Jan.	319	1.46	466
	Feb.	396	1.28	507		Feb.	458	1.14	522		Feb.	342	1.30	444
	Mar.	630	1.16	731		Mar.	645	1.14	735		Mar.	393	1.24	487
	Apr.	2,844	.55	1,564		Apr.	1,703	.64	1,090		Apr.	546	1.00	546
	May	3,209	.46	1,476		May	3,507	.38	1,333		May	1,277	.56	715
	June	4,202	.29	1,219		June	3,339	.34	1,135		June	792	.63	499
-1942	July	1,317	.57	751	-1948	July	980	.65	637	-1954	July	647	.87	563
	Aug.	454	1.08	490		Aug.	531	1.23	653		Aug.	321	1.19	382
	Sept.	275	1.59	438		Sept.	230	1.40	322		Sept.	389	1.66	645
	Oct.	334	1.58	528		Oct.	331	1.65	545		Oct.	512	1.43	733
	Nov.	368	1.58	582		Nov.	408	1.46	595		Nov.	349	1.39	485
	Dec.	357	1.54	550		Dec.	347	1.40	485		Dec.	278	1.51	421
	Total	14,793	.63	9,381		Total	12,885	.66	8,531		Total	6,165	1.04	6,386
	Jan.	330	1.50	494		Jan.	337	1.39	469		Jan.	244	1.58	386
	Feb.	332	1.41	469		Feb.	361	1.25	451		Feb.	243	1.39	338
	Mar.	516	1.19	614		Mar.	706	1.18	834		Mar.	580	1.29	748
	Apr.	1,450	.67	971		Apr.	1,307	.78	1,020		Apr.	617	1.05	649
	May	2,158	.43	928		May	3,098	.43	1,332		May	1,570	.56	879
	June	2,729	.40	1,092		June	4,419	.41	1,812		June	1,586	.49	777
-1943	July	1,429	.47	672	-1949	July	2,137	.52	1,111	-1955	July	571	.70	399
	Aug.	793	1.09	864		Aug.	576	1.00	576		Aug.	510	1.40	713
	Sept.	447	1.15	514		Sept.	313	1.51	473		Sept.	230	1.60	368
	Oct.	378	1.60	604		Oct.	509	1.48	753		Oct.	214	1.70	363
	Nov.	456	1.35	616		Nov.	473	1.31	619		Nov.	275	1.67	458
	Dec.	395	1.36	537		Dec.	368	1.37	504		Dec.	326	1.44	470
	Total	11,413	.73	8,375		Total	14,604	.68	9,954		Total	6,966	.94	6,548
	Jan.	278	1.50	418		Jan.	350	1.41	493		Jan.	373	1.28	477
	Feb.	344	1.32	454		Feb.	399	1.23	490		Feb.	280	1.39	390
	Mar.	509	1.31	668		Mar.	650	1.11	721		Mar.	511	1.16	592
	Apr.	1,027	.89	914		Apr.	1,217	.74	900		Apr.	898	.75	673
	May	3,251	.47	1,528		May	1,971	.49	966		May	2,190	.48	1,051
	June	4,136	.32	1,323		June	2,979	.37	1,102		June	2,594	.39	1,012
-1944	July	1,782	.45	802	-1950	July	1,377	.67	923	-1956	July	557	.75	418
	Aug.	417	1.07	446		Aug.	422	1.02	430		Aug.	356	1.33	473
	Sept.	229	1.50	343		Sept.	330	1.47	485		Sept.	166	1.48	246
	Oct.	342	1.66	567		Oct.	342	1.47	502		Oct.	186	1.74	324
	Nov.	384	1.51	579		Nov.	350	1.55	542		Nov.	300	1.58	474
	Dec.	320	1.51	483		Dec.	415	1.31	544		Dec.	247	1.55	383
	Total	13,019	.65	8,525		Total	10,802	.75	8,098		Total	8,658	.75	6,513
	Jan.	325	1.48	481		Jan.	315	1.43	451		Jan.	284	1.46	415
	Feb.	352	1.39	489		Feb.	361	1.25	451		Feb.	323	1.34	433
	Mar.	437	1.28	559		Mar.	418	1.19	497		Mar.	498	1.23	613
	Apr.	755	.99	748		Apr.	531	1.00	531		Apr.	828	.90	745
	May	2,805	.44	1,234		May	1,645	.57	938		May	2,569	.56	1,439
	June	2,761	.37	1,021		June	2,886	.41	1,184		June	5,645	.39	2,201
-1945	July	1,668	.47	784	-1951	July	1,357	.48	651	-1957	July	4,015	.43	1,727
	Aug.	1,011	.89	900		Aug.	787	1.11	874		Aug.	1,604	.78	1,251
	Sept.	370	1.28	474		Sept.	411	1.32	542		Sept.	822	1.03	847
	Oct.	505	1.51	763		Oct.	412	1.47	606		Oct.	748	1.54	1,150
	Nov.	443	1.34	594		Nov.	445	1.41	628		Nov.	848	1.39	1,179
	Dec.	337	1.35	454		Dec.	333	1.44	480		Dec.	516	1.25	646
	Total	11,769	.72	8,501		Total	9,901	.79	7,833		Total	18,700	.68	12,646
	Jan.	366	1.28	468		Jan.	476	1.23	586		Jan.	397	1.27	504
	Feb.	319	1.24	396		Feb.	379	1.26	478		Feb.	536	1.18	632
	Mar.	496	1.15	570		Mar.	440	1.31	576		Mar.	696	1.10	766
	Apr.	1,013	.83	841		Apr.	2,267	.74	1,677		Apr.	1,574	.64	1,007
	May	1,732	.47	814		May	5,081	.41	2,083		May	3,992	.46	1,836
	June	1,993	.43	857		June	5,192	.36	1,869		June	3,678	.40	1,471
-1946	July	730	.73	533	-1952	July	1,573	.55	865	-1958	July	628	.74	465
	Aug.	478	1.28	612		Aug.	821	1.06	870		Aug.	286	1.43	409
	Sept.	310	1.62	502		Sept.	542	1.31	710		Sept.	319	1.69	540
	Oct.	403	1.50	604		Oct.	368	1.43	527		Oct.	310	1.63	505
	Nov.	466	1.30	607		Nov.	386	1.55	599		Nov.	357	1.65	589
	Dec.	445	1.22	542		Dec.	378	1.47	556		Dec.	366	1.52	556
	Total	8,751	.84	7,346		Total	17,903	.64	11,396		Total	13,139	.71	9,280

To obtain mg/l multiply T/AF by 735.

Table 12

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Lees Ferry, Arizona

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
1959	Jan.	315	1.48	466
	Feb.	315	1.36	428
	Mar.	344	1.37	471
	Apr.	420	1.16	487
	May	1,025	.70	718
	June	1,836	.48	881
	July	782	.63	493
	Aug.	425	1.43	608
	Sept.	246	1.68	413
	Oct.	502	1.41	708
	Nov.	499	1.21	604
	Dec.	352	1.39	489
	Total	7,061	.96	6,766
1960	Jan.	305	1.54	470
	Feb.	318	1.34	426
	Mar.	745	1.18	879
	Apr.	1,610	.62	998
	May	1,564	.51	798
	June	2,239	.43	963
	July	647	.69	446
	Aug.	208	1.38	287
	Sept.	193	1.90	367
	Oct.	341	1.67	569
	Nov.	345	1.47	507
	Dec.	275	1.39	382
	Total	8,790	.81	7,092
1961	Jan.	266	1.48	394
	Feb.	331	1.34	444
	Mar.	362	1.34	485
	Apr.	567	1.02	578
	May	1,153	.59	680
	June	1,588	.45	715
	July	369	.89	328
	Aug.	336	1.65	554
	Sept.	710	1.61	1,143
	Oct.	725	1.01	732
	Nov.	527	1.04	548
	Dec.	380	1.22	464
	Total	7,314	.97	7,065
1962	Jan.	349	1.24	433
	Feb.	791	1.03	815
	Mar.	598	1.13	676
	Apr.	2,391	.71	1,698
	May	3,633	.44	1,599
	June	2,876	.45	1,294
	July	1,717	.57	979
	Aug.	469	1.02	478
	Sept.	315	1.61	507
	Oct.	539	1.52	819
	Nov.	428	1.28	548
	Dec.	333	1.42	473
	Total	14,439	.71	10,319
1963	Jan.	169	1.69	286
	Feb.	369	1.35	498
	Mar.	188	1.35	254
	Apr.	60	1.44	86
	May	62	1.30	81
	June	140	1.13	158
	July	90	.95	86
	Aug.	62	.96	60
	Sept.	60	.90	54
	Oct.	61	.88	54
	Nov.	60	.95	57
	Dec.	63	1.34	84
	Total	1,384	1.27	1,758
1964	Jan.	71	1.33	94
	Feb.	231	1.33	307
	Mar.	388	1.29	500
	Apr.	771	1.24	956
	May	319	1.22	389
	June	60	1.24	74
	July	60	1.25	75
	Aug.	174	1.24	216
	Sept.	156	.69	108
	Oct.	268	.63	169
	Nov.	347	.84	292
	Dec.	398	1.00	398
	Total	3,243	1.10	3,578
1965	Jan.	558	0.98	547
	Feb.	515	1.02	525
	Mar.	556	1.01	562
	Apr.	1,222	1.03	1,259
	May	2,284	.95	2,170
	June	2,323	.88	2,044
	July	727	.48	349
	Aug.	871	.41	357
	Sept.	750	.40	300
	Oct.	659	.43	283
	Nov.	589	.47	277
	Dec.	531	.63	335
	Total	11,585	.78	9,008
1966	Jan.	451	0.73	329
	Feb.	483	.76	367
	Mar.	622	.76	473
	Apr.	825	.77	635
	May	978	.72	704
	June	754	.71	535
	July	658	.66	434
	Aug.	682	.65	443
	Sept.	622	.66	411
	Oct.	551	.65	358
	Nov.	584	.66	385
	Dec.	529	.69	365
	Total	7,739	.70	5,439
1967	Jan.	614	.76	467
	Feb.	534	.79	422
	Mar.	690	.89	614
	Apr.	788	1.03	812
	May	879	.93	817
	June	698	.99	691
	July	641	.81	519
	Aug.	693	.71	492
	Sept.	596	.75	447
	Oct.	415	.73	303
	Nov.	460	.76	350
	Dec.	552	.82	453
	Total	7,560	.84	6,387
1968	Jan.	633	.93	589
	Feb.	464	.97	450
	Mar.	858	1.02	875
	Apr.	968	1.02	987
	May	943	1.05	990
	June	894	1.00	894
	July	827	.81	670
	Aug.	685	.70	480
	Sept.	635	.70	444
	Oct.	620	.69	428
	Nov.	616	.67	413
	Dec.	639	.79	505
	Total	8,782	.88	7,725

To obtain mg/l multiply T/AF by 735.

Table 12
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River at Lees Ferry, Arizona
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	17,857	.70	514	12,481
1942	14,793	.63	466	9,381
1943	11,413	.73	539	8,375
1944	13,019	.65	481	8,525
1945	11,769	.72	531	8,501
1946	8,751	.84	617	7,346
1947	14,046	.68	498	9,513
1948	12,885	.66	487	8,531
1949	14,604	.68	501	9,954
1950	10,802	.75	551	8,098
1951	9,901	.79	581	7,833
1952	17,903	.64	468	11,396
1953	8,729	.86	630	7,485
1954	6,165	1.04	761	6,386
1955	6,966	.94	691	6,548
1956	8,658	.75	553	6,513
1957	18,700	.68	497	12,646
1958	13,139	.71	519	9,280
1959	7,061	.96	704	6,766
1960	8,790	.81	593	7,092
1961	7,314	.97	710	7,065
1962	14,439	.71	525	10,319
1963	1,384	1.27	934	1,758
1964	3,242	1.10	811	3,578
1965	11,585	.78	572	9,008
1966	7,739	.70	517	5,439
1967	7,560	.84	621	6,387
1968	8,782	.88	647	7,725
Total	297,990			223,929
Average	10,642	.75	552	7,997

Sampled quality record November 1942 to October 1945, October 1947 to December 1968; remainder by correlation.
Measured flow record entire period.

Table 13

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River near Grand Canyon, Arizona

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	434	1.42	616
	Feb.	515	1.31	675
	Mar.	838	1.17	980
	Apr.	1,209	.87	1,052
	May	4,976	.50	2,488
	June	4,100	.45	1,845
-1941	July	1,753	.55	964
	Aug.	861	1.29	1,111
	Sept.	659	1.43	942
	Oct.	1,904	1.14	2,171
	Nov.	953	.98	934
	Dec.	594	1.22	725
	Total	18,796	.77	14,503
	Jan.	430	1.40	602
	Feb.	435	1.33	579
	Mar.	653	1.25	816
	Apr.	2,763	.60	1,658
	May	3,163	.49	1,550
	June	4,241	.32	1,357
-1942	July	1,345	.59	794
	Aug.	486	1.15	559
	Sept.	294	1.67	491
	Oct.	356	1.67	575
	Nov.	386	1.67	645
	Dec.	373	1/1.50	560
	Total	14,925	.68	10,186
	Jan.	347	1/1.49	517
	Feb.	351	1/1.48	519
	Mar.	580	1/1.26	731
	Apr.	1,417	1/ .83	1,176
	May	2,161	1/ .57	1,232
	June	2,676	1/ .49	1,311
-1943	July	1,459	1/ .60	875
	Aug.	834	1/1.17	976
	Sept.	494	1/1.40	692
	Oct.	408	1.69	690
	Nov.	477	1.47	701
	Dec.	420	1.46	613
	Total	11,624	.86	10,033
	Jan.	298	1.61	480
	Feb.	363	1.23	446
	Mar.	551	1.41	777
	Apr.	1,099	.95	1,044
	May	3,206	.55	1,763
	June	4,144	.41	1,699
-1944	July	1,854	.52	964
	Aug.	456	1.14	520
	Sept.	251	1.61	404
	Oct.	362	1.78	644
	Nov.	401	1.64	658
	Dec.	345	1.59	549
	Total	13,330	.75	9,948
	Jan.	356	1.55	552
	Feb.	381	1.48	564
	Mar.	472	1.41	666
	Apr.	804	1.01	812
	May	2,803	.52	1,458
	June	2,754	.48	1,322
-1945	July	1,732	.56	970
	Aug.	1,071	1.05	1,125
	Sept.	394	1.38	544
	Oct.	524	1.63	854
	Nov.	465	1.51	702
	Dec.	359	1.47	528
	Total	12,115	.83	10,097
	Jan.	384	1.41	541
	Feb.	333	1.38	460
	Mar.	514	1.29	663
	Apr.	1,016	.94	955
	May	1,775	.53	941
	June	1,995	.54	1,077
-1946	July	784	.82	643
	Aug.	567	1.50	850
	Sept.	372	1.71	636
	Oct.	419	1.62	679
	Nov.	492	1.36	684
	Dec.	468	1.31	613
	Total	9,119	.96	8,742
	Jan.	303	1.50	455
	Feb.	371	1.38	512
	Mar.	653	1.18	771
	Apr.	785	.92	722
	May	3,088	.48	1,482
	June	3,233	.48	1,552
-1947	July	1,953	.50	976
	Aug.	1,329	1.17	1,555
	Sept.	640	1.26	806
	Oct.	894	1.28	1,144
	Nov.	608	1.14	693
	Dec.	490	1.28	627
	Total	14,347	.79	11,295
	Jan.	427	1.27	542
	Feb.	458	1.28	586
	Mar.	669	1.25	836
	Apr.	1,732	.74	1,282
	May	3,392	.45	1,526
	June	3,358	.40	1,343
-1948	July	1,009	.73	737
	Aug.	587	1.33	781
	Sept.	242	1.65	399
	Oct.	336	1.82	612
	Nov.	434	1.61	699
	Dec.	365	1.25	456
	Total	13,009	.75	9,[illegible]
	Jan.	363	1.51	548
	Feb.	374	1.36	509
	Mar.	796	1.20	955
	Apr.	1,337	.92	1,230
	May	2,959	.48	1,420
	June	4,303	.48	2,065
-1949	July	2,128	.58	1,234
	Aug.	632	1.12	708
	Sept.	340	1.65	561
	Oct.	521	1.58	823
	Nov.	488	1.36	664
	Dec.	381	1.41	537
	Total	14,622	.77	11,254
	Jan.	358	1.56	558
	Feb.	414	1.35	559
	Mar.	670	1.21	811
	Apr.	1,192	.88	1,049
	May	1,941	.59	1,145
	June	2,925	.47	1,375
-1950	July	1,401	.76	1,065
	Aug.	444	1.13	502
	Sept.	343	1.56	535
	Oct.	359	1.67	600
	Nov.	355	1.75	621
	Dec.	434	1.48	642
	Total	10,836	.87	9,462
	Jan.	326	1.59	518
	Feb.	366	1.45	531
	Mar.	429	1.35	579
	Apr.	535	1.17	626
	May	1,552	.67	1,040
	June	2,800	.49	1,372
-1951	July	1,397	.57	796
	Aug.	833	1.18	983
	Sept.	452	1.46	660
	Oct.	425	1.67	710
	Nov.	466	1.61	750
	Dec.	353	1.61	568
	Total	9,934	.92	9,133
	Jan.	593	1.28	759
	Feb.	396	1.42	562
	Mar.	435	1.46	635
	Apr.	2,209	.84	1,855
	May	5,062	.52	2,632
	June	5,203	.46	2,393
-1952	July	1,590	.65	1,033
	Aug.	833	1.18	983
	Sept.	596	1.43	852
	Oct.	393	1.52	597
	Nov.	396	1.64	649
	Dec.	400	1.58	632
	Total	18,806	.75	13,582
	Jan.	408	1.46	596
	Feb.	378	1.42	537
	Mar.	478	1.35	645
	Apr.	533	1.21	645
	May	989	.87	860
	June	2,932	.47	1,378
-1953	July	980	.76	745
	Aug.	703	1.30	914
	Sept.	290	1.73	502
	Oct.	325	1.88	611
	Nov.	428	1.63	698
	Dec.	360	1.56	562
	Total	8,804	.99	8,693
	Jan.	333	1.58	526
	Feb.	353	1.40	494
	Mar.	424	1.34	568
	Apr.	566	1.11	628
	May	1,211	.68	823
	June	798	.68	543
-1954	July	669	.95	636
	Aug.	349	1.32	461
	Sept.	415	1.67	693
	Oct.	526	1.52	800
	Nov.	360	1.47	529
	Dec.	296	1.60	474
	Total	6,300	1.14	7,175
	Jan.	261	1.70	444
	Feb.	269	1.50	404
	Mar.	586	1.35	791
	Apr.	621	1.15	714
	May	1,515	.59	894
	June	1,596	.55	878
-1955	July	618	.77	476
	Aug.	668	1.39	929
	Sept.	265	1.63	432
	Oct.	236	1.84	434
	Nov.	298	1/1.88	560
	Dec.	354	1/1.52	538
	Total	7,287	1.03	7,494
	Jan.	398	1/1.42	565
	Feb.	310	1.30	403
	Mar.	511	1.21	618
	Apr.	878	.82	720
	May	2,125	.49	1,041
	June	2,584	.45	1,163
-1956	July	598	.82	490
	Aug.	383	1.31	502
	Sept.	185	1.58	292
	Oct.	202	1.86	376
	Nov.	325	1.69	549
	Dec.	274	1.66	455
	Total	8,773	.82	7,174
	Jan.	343	1.45	497
	Feb.	370	1.37	507
	Mar.	541	1.26	682
	Apr.	812	.93	755
	May	2,501	.57	1,426
	June	5,541	.40	2,216
-1957	July	4,033	.40	1,613
	Aug.	1,672	.88	1,471
	Sept.	884	1.13	999
	Oct.	784	1.46	1,144
	Nov.	892	1.42	1,266
	Dec.	537	1.28	687
	Total	18,910	.70	13,263
	Jan.	415	1.31	544
	Feb.	536	1.24	665
	Mar.	749	1.13	846
	Apr.	1,580	.77	1,220
	May	3,900	.45	1,755
	June	3,763	.41	1,542
-1958	July	683	.91	622
	Aug.	337	1/1.31	440
	Sept.	379	1/1.32	500
	Oct.	346	1/1.53	530
	Nov.	385	1/1.53	590
	Dec.	388	1/1.55	600
	Total	13,461	.73	9,854

To obtain mg/l multiply T/AF by 735.

1/ Correlated.

Table 13
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Grand Canyon, Arizona
Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	334	1/1.56	520
	Feb.	326	1/1.53	500
	Mar.	365	1/1.53	560
-1959	Apr.	423	1.27	537
	May	1,011	.78	789
	June	1,804	.53	956
	July	795	.69	549
	Aug.	488	1.50	731
	Sept.	271	1.82	493
	Oct.	528	1.47	777
	Nov.	569	1.25	712
	Dec.	394	1.33	524
	Total	7,308	1.05	7,648
	Jan.	348	1.41	490
	Feb.	353	1.40	495
	Mar.	820	1.15	942
-1960	Apr.	1,650	.63	1,036
	May	1,580	.55	870
	June	2,212	.46	1,011
	July	678	.73	497
	Aug.	233	1.42	331
	Sept.	218	1.92	418
	Oct.	382	1.81	692
	Nov.	380	1.59	603
	Dec.	300	1.49	448
	Total	9,154	.86	7,833
	Jan.	291	1.58	460
	Feb.	353	1.39	490
	Mar.	379	1.40	530
-1961	Apr.	587	1.04	608
	May	1,147	.66	760
	June	1,692	.47	788
	July	417	.98	409
	Aug.	374	1.76	658
	Sept.	748	1.82	1,360
	Oct.	772	1.23	949
	Nov.	570	1.23	701
	Dec.	409	1.32	539
	Total	7,739	1.07	8,252
	Jan.	369	1.35	498
	Feb.	832	1.02	847
	Mar.	610	1.19	726
-1962	Apr.	2,467	.70	1,730
	May	3,716	.45	1,654
	June	2,850	.46	1,318
	July	1,821	.57	1,031
	Aug.	512	1.03	526
	Sept.	318	1.58	502
	Oct.	557	1.57	877
	Nov.	443	1.34	592
	Dec.	344	1.50	516
	Total	14,839	.73	10,817
	Jan.	182	1.84	334
	Feb.	374	1.33	496
	Mar.	203	1.37	279
-1963	Apr.	72	1.56	112
	May	79	1.49	118
	June	148	1.09	162
	July	108	1.14	123
	Aug.	112	1.29	145
	Sept.	122	1.43	175
	Oct.	77	1.39	107
	Nov.	76	1.39	106
	Dec.	77	1.74	134
	Total	1,630	1.41	2,291
	Jan.	79	1.75	138
	Feb.	245	1.52	373
	Mar.	382	1.47	562
-1964	Apr.	796	1.33	1,058
	May	356	1.36	485
	June	77	1.65	127
	July	84	1.75	147
	Aug.	287	1.31	376
	Sept.	191	1.05	200
	Oct.	298	.77	230
	Nov.	371	.87	323
	Dec.	416	1.04	431
	Total	3,582	1.24	4,450
	Jan.	608	1.06	644
	Feb.	539	1.09	588
	Mar.	568	1.09	619
	Apr.	1,251	1.04	1,301
	May	2,282	1.03	2,350
	June	2,282	.89	2,038
-1965	July	724	.59	427
	Aug.	879	.86	755
	Sept.	767	.51	391
	Oct.	675	.51	344
	Nov.	612	.53	322
	Dec.	586	.69	406
	Total	11,773	.86	10,185
	Jan.	529	0.79	418
	Feb.	524	.87	455
	Mar.	718	.81	582
	Apr.	865	.81	700
	May	1,011	.79	799
	June	789	.77	609
-1966	July	698	.75	523
	Aug.	694	.68	471
	Sept.	623	.75	468
	Oct.	567	.74	419
	Nov.	589	.71	418
	Dec.	620	.76	471
	Total	8,230	.77	6,333
	Jan.	648	.84	544
	Feb.	564	.86	485
	Mar.	704	.97	683
	Apr.	801	1.09	873
	May	861	1.00	861
	June	711	1.02	725
-1967	July	693	.92	638
	Aug.	786	.82	644
	Sept.	713	.90	642
	Oct.	459	.86	395
	Nov.	495	.83	411
	Dec.	597	.90	537
	Total	8,032	.93	7,438
	Jan.	658	1.01	664
	Feb.	534	1.04	555
	Mar.	900	1.03	927
	Apr.	1,078	1.02	1,100
	May	976	1.11	1,083
	June	925	1.03	953
-1968	July	865	.93	804
	Aug.	775	.81	628
	Sept.	675	.80	540
	Oct.	647	.79	511
	Nov.	675	.80	540
	Dec.	665	.77	512
	Total	9,373	.94	8,817
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
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	May			
	June			
	July			
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	Oct.			
	Nov.			
	Dec.			
	Total			
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	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 13
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River near Grand Canyon, Arizona
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	18,796	0.77	567	14,503
1942	14,925	.68	502	10,186
1943	11,624	.86	634	10,033
1944	13,330	.75	549	9,948
1945	12,115	.83	613	10,097
1946	9,119	.96	705	8,742
1947	14,347	.79	579	11,295
1948	13,009	.75	554	9,799
1949	14,622	.77	566	11,254
1950	10,836	.87	642	9,462
1951	9,934	.92	676	9,133
1952	18,106	.75	551	13,582
1953	8,804	.99	726	8,693
1954	6,300	1.14	837	7,175
1955	7,287	1.03	756	7,494
1956	8,773	.82	601	7,174
1957	18,910	.70	516	13,263
1958	13,461	.73	538	9,854
1959	7,308	1.05	769	7,648
1960	9,154	.86	629	7,833
1961	7,739	1.07	784	8,252
1962	14,839	.73	536	10,817
1963	1,630	1.41	1,030	2,291
1964	3,582	1.24	913	4,450
1965	11,773	.86	636	10,185
1966	8,230	.77	566	6,333
1967	8,032	.93	681	7,438
1968	9,373	.94	691	8,817
Total	305,958			255,751
Average	10,927	.84	614	9,134

Table 14

Colorado River Basin

Historical Flow and Quality of Water Data

Virgin River at Littlefield, Arizona

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	15	2.39	35
	Feb.	31	1.97	61
	Mar.	62	.82	51
	Apr.	62	.84	52
	May	131	.46	60
	June	19	1.75	34
-1941	July	22	2.45	54
	Aug.	20	3.02	62
	Sept.	6	3.29	18
	Oct.	23	3.22	74
	Nov.	19	2.26	43
	Dec.	17	2.28	39
	Total	427	1.37	583
	Jan.	20	2.25	44
	Feb.	16	2.28	35
	Mar.	20	1.88	38
	Apr.	50	1.01	51
	May	28	1.56	44
	June	5	3.15	16
-1942	July	4	3.31	14
	Aug.	9	3.29	29
	Sept.	4	3.31	13
	Oct.	9	3.41	31
	Nov.	10	2.78	29
	Dec.	11	2.72	31
	Total	186	2.01	375
	Jan.	18	2.32	42
	Feb.	21	2.14	45
	Mar.	36	1.28	47
	Apr.	34	1.36	46
	May	11	2.27	26
	June	4	3.35	13
-1943	July	4	3.31	14
	Aug.	13	3.35	42
	Sept.	6	3.46	20
	Oct.	9	3.40	30
	Nov.	10	2.79	28
	Dec.	13	2.51	32
	Total	179	2.15	385
	Jan.	13	2.47	33
	Feb.	15	2.31	35
	Mar.	26	1.64	42
	Apr.	25	1.66	42
	May	49	1.05	51
	June	11	2.32	25
-1944	July	4	3.32	13
	Aug.	4	3.31	13
	Sept.	4	3.31	14
	Oct.	5	3.30	16
	Nov.	13	2.48	32
	Dec.	12	2.65	31
	Total	181	1.92	347
	Jan.	11	2.68	30
	Feb.	17	2.15	38
	Mar.	20	1.87	38
	Apr.	20	1.83	36
	May	25	1.55	39
	June	5	3.22	15
-1945	July	5	3.31	15
	Aug.	26	3.06	79
	Sept.	8	3.19	25
	Oct.	20	3.14	62
	Nov.	10	2.75	29
	Dec.	14	2.47	35
	Total	181	2.43	441
	Jan.	13	2.48	32
	Feb.	10	2.74	27
	Mar.	10	2.63	28
	Apr.	12	2.49	29
	May	5	3.31	15
	June	4	3.32	13
-1946	July	6	3.40	21
	Aug.	13	3.17	42
	Sept.	4	3.31	13
	Oct.	37	2.18	81
	Nov.	33	1.85	61
	Dec.	22	2.12	47
	Total	169	2.42	409
	Jan.	15	2.34	35
	Feb.	12	2.46	30
	Mar.	13	2.32	31
	Apr.	16	2.17	34
	May	17	1.98	33
	June	4	3.31	14
-1947	July	5	3.30	16
	Aug.	14	2.97	41
	Sept.	4	3.31	14
	Oct.	8	3.34	27
	Nov.	9	2.89	27
	Dec.	14	2.46	34
	Total	131	2.56	336
	Jan.	11	2.76	29
	Feb.	12	2.47	30
	Mar.	13	2.42	31
	Apr.	20	1.87	37
	May	10	2.47	25
	June	4	3.32	14
-1948	July	4	3.31	14
	Aug.	5	3.31	18
	Sept.	6	3.39	20
	Oct.	6	3.34	20
	Nov.	10	2.87	27
	Dec.	10	2.85	29
	Total	111	2.65	294
	Jan.	13	2.52	32
	Feb.	14	2.42	35
	Mar.	18	2.07	36
	Apr.	30	1.43	44
	May	28	1.53	43
	June	12	2.11	25
-1949	July	4	3.19	14
	Aug.	4	3.20	13
	Sept.	7	3.27	23
	Oct.	9	3.07	26
	Nov.	11	2.68	29
	Dec.	13	2.51	34
	Total	163	2.17	354
	Jan.	15	2.20	33
	Feb.	16	2.00	32
	Mar.	14	2.26	31
	Apr.	15	2.05	31
	May	6	2.87	19
	June	4	3.28	13
-1950	July	12	3.38	40
	Aug.	6	3.43	19
	Sept.	6	3.35	20
	Oct.	5	3.40	17
	Nov.	9	3.14	28
	Dec.	10	2.91	30
	Total	118	2.65	313
	Jan.	11	2.77	30
	Feb.	8	2.84	22
	Mar.	8	2.83	23
	Apr.	7	3.17	22
	May	10	2.74	27
	June	4	3.37	12
-1951	July	6	3.34	20
	Aug.	16	3.27	55
	Sept.	6	3.20	20
	Oct.	7	3.24	22
	Nov.	9	2.94	26
	Dec.	20	2.42	49
	Total	112	2.93	328
	Jan.	21	2.34	49
	Feb.	11	2.52	28
	Mar.	27	1.74	48
	Apr.	80	.76	60
	May	71	.68	49
	June	12	1.75	21
-1952	July	4	3.27	14
	Aug.	5	3.43	18
	Sept.	6	3.34	20
	Oct.	6	3.40	20
	Nov.	10	2.84	29
	Dec.	14	2.53	34
	Total	267	1.46	390
	Jan.	14	2.36	32
	Feb.	9	2.70	24
	Mar.	7	2.98	21
	Apr.	6	3.27	20
	May	5	3.27	16
	June	4	3.34	14
-1953	July	8	3.46	28
	Aug.	13	3.04	40
	Sept.	4	3.38	13
	Oct.	7	3.31	24
	Nov.	10	3.07	29
	Dec.	11	2.83	31
	Total	98	3.00	292
	Jan.	15	2.49	37
	Feb.	12	2.36	29
	Mar.	17	1.98	33
	Apr.	23	1.64	38
	May	10	2.35	23
	June	5	3.36	18
-1954	July	8	3.42	26
	Aug.	10	3.44	34
	Sept.	9	3.56	32
	Oct.	9	3.48	30
	Nov.	9	3.13	29
	Dec.	13	2.71	36
	Total	140	2.61	365
	Jan.	12	2.60	31
	Feb.	12	2.51	30
	Mar.	11	2.53	27
	Apr.	6	3.14	19
	May	5	3.18	16
	June	4	3.39	13
-1955	July	10	3.61	37
	Aug.	40	3.69	149
	Sept.	5	3.26	15
	Oct.	5	3.51	19
	Nov.	10	3.05	31
	Dec.	13	2.60	34
	Total	133	3.16	421
	Jan.	15	2.53	38
	Feb.	11	2.59	29
	Mar.	8	2.87	22
	Apr.	6	3.13	18
	May	4	3.23	15
	June	4	3.34	15
-1956	July	8	3.53	27
	Aug.	4	3.35	13
	Sept.	4	3.35	12
	Oct.	4	3.39	14
	Nov.	6	3.50	21
	Dec.	8	3.29	25
	Total	82	3.05	249
	Jan.	12	2.77	33
	Feb.	14	2.32	32
	Mar.	10	2.64	26
	Apr.	6	2.99	18
	May	15	2.04	31
	June	9	2.85	25
-1957	July	4	3.31	13
	Aug.	9	3.41	31
	Sept.	4	3.27	12
	Oct.	14	3.02	44
	Nov.	21	2.45	51
	Dec.	15	2.04	31
	Total	133	2.61	347
	Jan.	10	2.49	24
	Feb.	19	1.83	35
	Mar.	41	1.43	59
	Apr.	64	1.02	65
	May	69	1.05	73
	June	7	2.29	16
-1958	July	6	3.17	19
	Aug.	5	3.22	18
	Sept.	22	3.13	70
	Oct.	8	3.16	24
	Nov.	11	2.62	28
	Dec.	10	2.67	26
	Total	272	1.68	457

To obtain mg/l multiply T/AF by 735.

Table 14
Colorado River Basin
Historical Flow and Quality of Water Data
Virgin River at Littlefield, Arizona
Units-1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	10	2.58	27
	Feb.	13	2.30	31
	Mar.	9	2.67	24
	Apr.	4	3.05	13
	May	4	3.07	13
	June	4	3.24	12
-1959	July	4	3.32	13
	Aug.	12	3.35	40
	Sept.	4	3.20	13
	Oct.	5	3.30	15
	Nov.	13	2.90	36
	Dec.	9	2.69	23
	Total	91	2.87	260
	Jan.	11	2.48	28
	Feb.	10	2.38	24
	Mar.	10	2.45	24
	Apr.	6	2.91	17
	May	5	3.03	14
	June	3	3.16	10
-1960	July	4	3.18	12
	Aug.	3	3.20	11
	Sept.	6	3.51	20
	Oct.	6	3.05	19
	Nov.	12	2.80	35
	Dec.	8	2.71	22
	Total	84	2.79	236
	Jan.	8	2.76	21
	Feb.	7	2.80	20
	Mar.	8	2.84	23
	Apr.	4	3.11	14
	May	4	3.14	12
	June	4	3.14	12
-1961	July	8	3.22	27
	Aug.	17	3.58	60
	Sept.	22	3.36	73
	Oct.	5	3.41	19
	Nov.	8	3.07	23
	Dec.	13	2.69	34
	Total	108	3.14	338
	Jan.	10	2.73	28
	Feb.	30	1.65	50
	Mar.	17	2.09	35
	Apr.	33	1.21	40
	May	9	2.24	19
	June	4	3.32	12
-1962	July	4	3.29	13
	Aug.	3	3.46	11
	Sept.	7	3.28	24
	Oct.	7	3.32	21
	Nov.	6	3.18	20
	Dec.	7	2.75	20
	Total	137	2.14	293
	Jan.	9	2.54	23
	Feb.	9	2.56	23
	Mar.	6	3.14	19
	Apr.	4	3.43	15
	May	4	3.41	13
	June	3	3.44	11
-1963	July	3	3.48	12
	Aug.	11	3.33	36
	Sept.	14	3.54	48
	Oct.	5	3.32	18
	Nov.	10	3.00	28
	Dec.	7	2.96	20
	Total	85	3.14	266
	Jan.	7	2.96	20
	Feb.	7	2.88	21
	Mar.	7	2.99	20
	Apr.	13	2.22	28
	May	11	2.22	24
	June	3	3.50	10
-1964	July	4	3.63	14
	Aug.	14	3.81	53
	Sept.	3	3.63	11
	Oct.	3	3.58	12
	Nov.	6	3.32	22
	Dec.	9	2.98	26
	Total	87	3.01	261

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	9	2.78	25
	Feb.	8	2.75	22
	Mar.	8	2.62	21
	Apr.	30	2.00	60
	May	23	1.52	35
	June	9	2.11	19
-1965	July	3	3.67	11
	Aug.	5	3.40	17
	Sept.	6	3.00	18
	Oct.	6	3.00	18
	Nov.	21	1.90	40
	Dec.	26	1.58	41
	Total	15[illegible]	2.12	327
	Jan.	13	2.31	30
	Feb.	11	2.45	27
	Mar.	14	1.50	29
	Apr.	17	1.70	29
	May	6	3.00	18
	June	3	4.00	12
-1966	July	3	4.00	12
	Aug.	3	3.67	11
	Sept.	4	3.50	14
	Oct.	6	3.33	20
	Nov.	9	2.78	25
	Dec.	73	1.99	145
	Total	162	2.30	372
	Jan.	13	2.66	34
	Feb.	9	2.67	25
	Mar.	10	2.76	29
	Apr.	11	2.63	30
	May	20	1.88	37
	June	7	2.80	19
-1967	July	4	3.57	14
	Aug.	7	3.32	25
	Sept.	14	3.41	46
	Oct.	7	3.13	21
	Nov.	9	2.71	25
	Dec.	13	2.49	32
	Total	124	2.72	337
	Jan.	13	2.60	33
	Feb.	15	2.19	32
	Mar.	12	2.16	27
	Apr.	15	2.03	30
	May	17	1.80	30
	June	5	2.81	13
-1968	July	6	3.52	20
	Aug.	14	3.09	45
	Sept.	3	3.60	12
	Oct.	6	3.41	20
	Nov.	7	3.05	22
	Dec.	11	2.79	30
	Total	124	2.53	314
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			
	Jan.			
	Feb.			
	Mar.			
	Apr.			
	May			
	June			
	July			
	Aug.			
	Sept.			
	Oct.			
	Nov.			
	Dec.			
	Total			

To obtain mg/l multiply T/AF by 735.

Table 14
Colorado River Basin
Historical Flow and Quality of Water Data
Virgin River at Littlefield, Arizona
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	427	1.37	1,000	583
1942	186	2.01	1,480	375
1943	179	2.15	1,580	385
1944	181	1.92	1,410	347
1945	181	2.43	1,790	441
1946	169	2.42	1,780	409
1947	131	2.56	1,890	336
1948	111	2.65	1,950	294
1949	163	2.17	1,600	354
1950	118	2.65	1,950	313
1951	112	2.93	2,150	328
1952	267	1.46	1,070	390
1953	98	3.00	2,190	292
1954	140	2.61	1,920	365
1955	133	3.16	2,330	421
1956	82	3.05	2,230	249
1957	133	2.61	1,920	347
1958	272	1.68	1,230	457
1959	91	2.87	2,100	260
1960	84	2.79	2,060	236
1961	108	3.14	2,300	338
1962	137	2.14	1,570	293
1963	85	3.14	2,300	266
1964	87	3.01	2,200	261
1965	154	2.12	1,560	327
1966	162	2.30	1,690	372
1967	124	2.72	1,980	337
1968	124	2.53	1,860	314
Total	4,239			9,690
Average	151	2.29	1,680	346

Table 15

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Hoover Dam, Arizona - Nevada

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	589	1.08	636
	Feb.	500	1.11	555
	Mar.	552	1.10	607
	Apr.	518	1.08	560
	May	1,435	1.08	1,550
	June	1,810	1.07	1,935
-1941	July	951	1.06	1,007
	Aug.	1,429	.97	1,386
	Sept.	1,576	.94	1,481
	Oct.	1,641	.94	1,543
	Nov.	1,817	.93	1,690
	Dec.	2,071	.94	1,947
	Total	14,889	1.00	14,897
	Jan.	2,011	1.00	2,011
	Feb.	1,550	.99	1,535
	Mar.	1,425	1.00	1,425
	Apr.	1,301	1.00	1,301
	May	1,343	1.00	1,343
	June	1,561	1.01	1,577
-1942	July	1,285	.99	1,272
	Aug.	846	.99	838
	Sept.	1,025	.98	1,005
	Oct.	1,163	.95	1,105
	Nov.	1,095	.90	986
	Dec.	1,157	.85	983
	Total	15,762	.98	15,381
	Jan.	1,109	.87	965
	Feb.	823	.89	732
	Mar.	971	.94	913
	Apr.	915	.95	869
	May	1,029	.94	967
	June	1,040	.93	967
-1943	July	1,109	.91	1,009
	Aug.	1,042	.92	959
	Sept.	1,042	.91	948
	Oct.	1,179	.90	1,061
	Nov.	1,179	.86	1,014
	Dec.	1,277	.86	1,098
	Total	12,715	.90	11,502
	Jan.	1,303	.88	1,147
	Feb.	1,269	.97	1,231
	Mar.	1,307	.96	1,254
	Apr.	1,170	.97	1,135
	May	1,216	.98	1,192
	June	1,097	.95	1,042
-1944	July	1,111	.93	1,033
	Aug.	1,211	.92	1,113
	Sept.	1,132	.89	1,007
	Oct.	1,226	1/ .94	1,152
	Nov.	1,186	1/ .99	1,174
	Dec.	1,199	.94	1,127
	Total	14,427	.94	13,607
	Jan.	1,239	.93	1,152
	Feb.	1,100	1/ .96	1,056
	Mar.	1,250	2/ .96	1,200
	Apr.	1,042	1/ .95	990
	May	1,068	1/ .90	961
	June	1,014	2/ .91	923
-1945	July	861	.92	792
	Aug.	885	1/ .93	823
	Sept.	869	1/ .90	782
	Oct.	1,080	1/ .88	950
	Nov.	1,042	1/ .90	938
	Dec.	1,062	1/ .89	945
	Total	12,512	.92	11,512
	Jan.	1,116	.87	971
	Feb.	1,047	1/ .95	994
	Mar.	1,004	.88	884
	Apr.	*872	.89	*776
	May	903	1/ .96	867
	June	817	1/ .92	752
-1946	July	838	.90	754
	Aug.	751	1/ .91	683
	Sept.	759	2/ .91	691
	Oct.	857	1/ .92	788
	Nov.	762	2/ .91	693
	Dec.	859	1/ .90	773
	Total	*10,585	.91	*9,626

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	984	0.90	886
	Feb.	886	.91	806
	Mar.	956	.92	879
	Apr.	859	1/ .99	850
	May	951	1/ 1.03	979
	June	919	1/ .95	873
-1947	July	925	.96	888
	Aug.	865	1/ .92	796
	Sept.	843	2/ .92	776
	Oct.	828	1/ .92	762
	Nov.	880	2/ .92	810
	Dec.	1,063	1/ .92	978
	Total	10,959	.94	10,283
	Jan.	1,169	2/ .93	1,087
	Feb.	1,138	1/ .93	1,058
	Mar.	1,150	1/ .93	1,070
	Apr.	1,202	1/ .97	1,166
	May	1,142	1/ .93	1,062
	June	1,076	1/ .88	947
-1948	July	1,156	1/ .86	994
	Aug.	968	2/ .86	833
	Sept.	981	1/ .85	834
	Oct.	917	1/ .80	734
	Nov.	1,028	.88	905
	Dec.	1,124	1/ .91	1,023
	Total	13,051	.90	11,713
	Jan.	1,212	.83	1,006
	Feb.	1,214	1/ .84	1,020
	Mar.	1,291	1/ .85	1,097
	Apr.	1,178	1/ .86	1,013
	May	1,026	1/ .83	852
	June	986	.87	858
-1949	July	1,020	.84	857
	Aug.	1,062	.80	850
	Sept.	1,141	.78	890
	Oct.	1,176	.75	882
	Nov.	1,022	1/ .83	848
	Dec.	1,238	.87	1,077
	Total	13,566	.83	11,250
	Jan.	1,277	.83	1,060
	Feb.	1,132	.81	917
	Mar.	1,246	.85	1,059
	Apr.	1,089	.85	926
	May	1,120	1/ .84	941
	June	960	1/ .83	797
-1950	July	982	.79	776
	Aug.	872	1/ .82	715
	Sept.	824	1/ .79	651
	Oct.	848	.89	755
	Nov.	815	.88	717
	Dec.	851	.86	732
	Total	12,016	.84	10,046
	Jan.	928	.87	807
	Feb.	756	.87	658
	Mar.	860	.91	783
	Apr.	796	.93	740
	May	898	.92	826
	June	691	.91	629
-1951	July	783	.92	720
	Aug.	907	.93	844
	Sept.	848	.92	780
	Oct.	756	.93	703
	Nov.	818	.93	761
	Dec.	829	.91	754
	Total	9,870	.91	9,005
	Jan.	1,070	.90	963
	Feb.	1,212	.93	1,127
	Mar.	1,371	.94	1,289
	Apr.	1,385	.94	1,302
	May	1,532	.94	1,440
	June	1,432	.91	1,303
-1952	July	1,304	.83	1,082
	Aug.	1,307	.79	1,033
	Sept.	1,359	.73	992
	Oct.	1,291	.69	891
	Nov.	1,215	.66	802
	Dec.	1,338	.88	1,177
	Total	15,816	.85	13,401

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	1,227	0.93	1,141
	Feb.	1,043	.91	949
	Mar.	1,046	.93	973
	Apr.	971	.94	913
	May	998	.91	908
-1953	June	819	.89	729
	July	897	.87	780
	Aug.	968	.87	842
	Sept.	968	.86	832
	Oct.	802	.86	690
	Nov.	749	.86	644
	Dec.	814	.85	692
	Total	11,302	.89	10,093
	Jan.	836	.88	736
	Feb.	721	.94	678
	Mar.	911	.95	865
	Apr.	975	.94	916
	May	1,101	.93	1,024
	June	929	.94	873
-1954	July	1,027	.94	965
	Aug.	888	.97	861
	Sept.	933	.97	905
	Oct.	776	.94	729
	Nov.	676	.95	642
	Dec.	741	.97	719
	Total	10,514	.94	9,913
	Jan.	725	.99	718
	Feb.	705	1.04	733
	Mar.	906	1.08	978
	Apr.	882	1.11	979
	May	928	1.12	1,039
	June	680	1.12	762
-1955	July	847	1.11	940
	Aug.	789	1.12	884
	Sept.	622	1.11	690
	Oct.	526	1.12	589
	Nov.	487	1.12	545
	Dec.	492	1.09	536
	Total	8,589	1.09	9,393
	Jan.	583	1.09	635
	Feb.	499	1.10	549
	Mar.	769	1.12	861
	Apr.	840	1.14	958
	May	748	1.15	860
	June	784	1.17	917
-1956	July	782	1.19	931
	Aug.	696	1.17	814
	Sept.	610	1.15	702
	Oct.	490	1.16	568
	Nov.	554	1.12	620
	Dec.	457	1.10	503
	Total	7,812	1.14	8,918
	Jan.	534	1.07	571
	Feb.	470	1.08	508
	Mar.	739	1.11	820
	Apr.	890	1.09	970
	May	769	1.07	823
	June	828	1.06	878
-1957	July	786	1.05	825
	Aug.	786	1.03	810
	Sept.	785	1.02	801
	Oct.	697	1.02	711
	Nov.	958	.99	948
	Dec.	1,081	.94	1,016
	Total	9,323	1.04	9,681
	Jan.	1,245	.90	1,120
	Feb.	846	.94	795
	Mar.	1,435	.90	1,292
	Apr.	1,473	.88	1,296
	May	1,115	.84	937
	June	819	.85	696
-1958	July	894	.85	760
	Aug.	911	.83	756
	Sept.	792	.83	657
	Oct.	728	.82	597
	Nov.	746	.82	612
	Dec.	873	.83	725
	Total	11,877	.86	10,243

To obtain mg/l multiply T/AF by 735.
*Revised
1/ Estimated or partially estimated.
2/ Average of adjacent values.

Table 15

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Hoover Dam, Arizona - Nevada

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	795	0.85	676
	Feb.	648	.83	537
	Mar.	827	.88	728
	Apr.	916	.91	834
	May	949	.86	816
	June	760	.85	646
	July	848	.84	713
-1959	Aug.	894	.83	742
	Sept.	773	.81	626
	Oct.	693	.82	568
	Nov.	607	.81	492
	Dec.	572	.81	463
	Total	9,282	.84	7,841
	Jan.	629	.86	541
	Feb.	512	.89	456
	Mar.	710	.89	632
	Apr.	909	.93	845
	May	856	.93	796
	June	1,015	.92	934
	July	984	.89	876
-1960	Aug.	959	.93	892
	Sept.	806	.93	749
	Oct.	556	.92	512
	Nov.	489	.92	450
	Dec.	572	.92	526
	Total	8,997	.91	8,209
	Jan.	591	.93	549
	Feb.	577	.94	543
	Mar.	936	.95	889
	Apr.	904	.97	877
	May	943	.95	896
	June	842	.94	791
	July	822	.94	772
-1961	Aug.	739	.96	709
	Sept.	690	.96	663
	Oct.	539	.93	502
	Nov.	517	.94	486
	Dec.	486	.95	462
	Total	8,586	.95	8,139
	Jan.	482	.93	448
	Feb.	497	1/.94	467
	Mar.	798	1/.94	750
	Apr.	902	1/.95	857
	May	887	1.00	887
	June	799	1/.94	751
	July	824	1/.91	750
-1962	Aug.	857	1/.87	746
	Sept.	716	1.00	716
	Oct.	634	1/.86	545
	Nov.	613	1/.90	552
	Dec.	606	1/.93	564
	Total	8,615	1/.93	8,033
	Jan.	482	.99	478
	Feb.	575	1/.97	558
	Mar.	871	1/.95	828
	Apr.	865	1/.94	813
	May	911	.93	847
	June	764	1/.92	702
	July	908	1/.91	826
-1963	Aug.	857	.90	771
	Sept.	724	.89	645
	Oct.	527	.90	475
	Nov.	464	.89	413
	Dec.	585	.90	526
	Total	8,533	1/.92	7,882
	Jan.	633	.93	589
	Feb.	583	.94	548
	Mar.	800	.95	760
	Apr.	859	.98	842
	May	844	.98	827
	June	719	.99	712
	July	866	.98	849
-1964	Aug.	731	.99	724
	Sept.	623	.99	616
	Oct.	591	1.01	596
	Nov.	445	1.02	454
	Dec.	469	1.06	497
	Total	8,163	.98	8,014
	Jan.	489	1.08	528
	Feb.	498	1.09	543
	Mar.	786	1.15	903
	Apr.	698	1.14	796
	May	872	1.14	994
	June	786	1.08	848
	July	815	1.08	880
-1965	Aug.	817	1.11	907
	Sept.	655	1.12	734
	Oct.	535	1.05	562
	Nov.	418	1.03	430
	Dec.	423	1.06	449
	Total	7,792	1.10	8,574
	Jan.	252	1.03	260
	Feb.	436	1.02	445
	Mar.	785	1.05	824
	Apr.	846	1.05	888
	May	887	1.03	914
	June	783	1.06	831
	July	889	1.01	897
-1966	Aug.	839	.98	822
	Sept.	672	1.00	672
	Oct.	467	.96	448
	Nov.	473	.93	440
	Dec.	448	.93	416
	Total	7,777	1.01	7,857
	Jan.	500	.94	470
	Feb.	574	.92	528
	Mar.	847	.91	771
	Apr.	771	.90	694
	May	889	.93	827
	June	782	.94	735
	July	832	.90	749
-1967	Aug.	755	.90	679
	Sept.	494	.93	459
	Oct.	576	.93	536
	Nov.	556	.91	506
	Dec.	356	.92	328
	Total	7,932	.92	7,282
	Jan.	396	.94	372
	Feb.	496	.92	456
	Mar.	850	.93	791
	Apr.	883	.93	821
	May	853	.95	810
	June	752	.93	699
	July	757	.94	712
-1968	Aug.	693	.97	672
	Sept.	663	.97	643
	Oct.	486	.98	476
	Nov.	457	.99	452
	Dec.	553	1.00	553
	Total	7,839	.95	7,457

To obtain mg/l multiply T/AF by 735.

1/Estimated or partially estimated.

Table 15
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River below Hoover Dam, Arizona, Nevada
(Annual Summary)

Units - 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./l)	T.D.S. (Tons)
1941	14,889	1.00	735	14,897
1942	15,762	.98	717	15,381
1943	12,715	.90	665	11,502
1944	14,427	.94	693	13,607
1945	12,512	.92	676	11,512
1946	10,585	.91	668	9,626
1947	10,959	.94	690	10,283
1948	13,051	.90	660	11,713
1949	13,566	.83	610	11,250
1950	12,016	.84	614	10,046
1951	9,870	.91	671	9,005
1952	15,816	.85	623	13,401
1953	11,302	.89	656	10,093
1954	10,514	.94	693	9,913
1955	8,589	1.09	804	9,393
1956	7,812	1.14	839	8,918
1957	9,323	1.04	763	9,681
1958	11,877	.86	634	10,243
1959	9,282	.84	621	7,841
1960	8,997	.91	671	8,209
1961	8,586	.95	697	8,139
1962	8,615	.93	685	8,033
1963	8,533	.92	677	7,882
1964	8,163	.98	722	8,014
1965	7,792	1.10	809	8,574
1966	7,777	1.01	743	7,857
1967	7,932	.92	675	7,282
1968	7,839	.95	699	7,457
Total	299,101			279,752
Average	10,682	.94	687	9,991

Measured flow record entire period.

Table 16

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Parker Dam, Arizona-California

Units-1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	627	1.09	683
	Feb.	561	1.12	628
	Mar.	750	1.11	833
	Apr.	608	1.09	663
	May	1,359	1.09	1,481
	June	1,628	1.08	1,758
-1941	July	998	1.07	1,068
	Aug.	1,332	1.01	1,345
	Sept.	1,528	.95	1,452
	Oct.	1,585	.95	1,506
	Nov.	1,731	.92	1,593
	Dec.	2,042	1.00	2,042
	Total	14,749	1.02	15,052
	Jan.	1,957	.97	1,898
	Feb.	1,482	.97	1,438
	Mar.	1,494	.96	1,434
	Apr.	1,136	.98	1,113
	May	1,588	.98	1,556
	June	1,536	.98	1,505
-1942	July	1,226	.95	1,165
	Aug.	880	1.04	915
	Sept.	797	.97	773
	Oct.	845	.96	811
	Nov.	1,041	.96	999
	Dec.	1,213	.87	1,055
	Total	15,195	.96	14,662
	Jan.	1,015	.91	924
	Feb.	746	.86	642
	Mar.	886	.95	842
	Apr.	877	.93	816
	May	957	.95	909
	June	976	.96	937
-1943	July	1,086	.89	967
	Aug.	990	.89	881
	Sept.	1,006	.88	885
	Oct.	1,160	.89	1,032
	Nov.	1,149	.85	977
	Dec.	1,231	.85	1,046
	Total	12,079	.90	10,858
	Jan.	1,241	.88	1,092
	Feb.	1,223	.90	1,101
	Mar.	1,297	.93	1,206
	Apr.	1,164	.95	1,106
	May	1,116	.95	1,060
	June	983	.96	944
-1944	July	1,035	.93	963
	Aug.	1,148	.93	1,068
	Sept.	1,114	.87	969
	Oct.	1,178	.86	1,013
	Nov.	1,156	.86	994
	Dec.	1,187	.91	1,080
	Total	13,842	.91	12,596
	Jan.	1,186	.92	1,091
	Feb.	1,061	.89	944
	Mar.	1,232	.91	1,121
	Apr.	985	.92	906
	May	970	.92	892
	June	919	.97	891
-1945	July	913	.90	822
	Aug.	770	.88	678
	Sept.	824	.89	733
	Oct.	1,038	.83	862
	Nov.	1,036	.87	901
	Dec.	1,099	.88	967
	Total	12,033	.90	10,808
	Jan.	1,041	.88	916
	Feb.	1,028	.94	966
	Mar.	944	.87	821
	Apr.	830	.90	747
	May	873	.92	803
	June	754	.90	679
-1946	July	801	.89	713
	Aug.	722	.87	628
	Sept.	730	.89	650
	Oct.	759	.89	676
	Nov.	789	.89	702
	Dec.	870	.89	774
	Total	10,141	.89	9,075

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	953	0.89	848
	Feb.	899	.90	809
	Mar.	940	.92	865
	Apr.	797	.95	757
	May	905	.96	869
	June	860	.96	826
-1947	July	844	.95	802
	Aug.	892	.94	838
	Sept.	819	.95	778
	Oct.	837	.89	745
	Nov.	880	.85	748
	Dec.	1,037	.81	840
	Total	10,663	.91	9,725
	Jan.	1,160	.93	1,079
	Feb.	1,160	.89	1,032
	Mar.	1,107	.89	985
	Apr.	1,083	.90	975
	May	1,115	.89	992
	June	989	.91	900
-1948	July	1,108	.88	975
	Aug.	986	.87	858
	Sept.	941	.86	809
	Oct.	918	.84	771
	Nov.	978	.79	773
	Dec.	1,106	.90	995
	Total	12,651	.88	11,144
	Jan.	1,229	.87	1,069
	Feb.	1,192	.83	989
	Mar.	1,236	.82	1,014
	Apr.	1,116	.86	960
	May	983	.86	845
	June	923	.87	803
-1949	July	952	.87	828
	Aug.	1,013	.82	831
	Sept.	1,099	.81	890
	Oct.	1,148	.78	895
	Nov.	1,011	.75	758
	Dec.	1,158	.72	834
	Total	13,060	.82	10,716
	Jan.	1,080	.84	907
	Feb.	1,036	.83	860
	Mar.	1,209	.82	991
	Apr.	998	.86	858
	May	1,066	.86	917
	June	900	.85	765
-1950	July	897	.83	745
	Aug.	833	.82	683
	Sept.	704	.82	577
	Oct.	651	.84	547
	Nov.	542	.86	466
	Dec.	557	.87	485
	Total	10,473	.84	8,801
	Jan.	550	.87	479
	Feb.	501	.88	441
	Mar.	730	.88	642
	Apr.	765	.87	666
	May	675	.88	594
	June	862	.88	759
-1951	July	945	.89	841
	Aug.	945	.87	822
	Sept.	723	.86	622
	Oct.	709	.88	624
	Nov.	560	.88	493
	Dec.	707	.89	629
	Total	8,672	.88	7,612
	Jan.	1,104	.89	983
	Feb.	1,134	.87	987
	Mar.	1,424	.87	1,239
	Apr.	1,300	.90	1,170
	May	1,443	.92	1,328
	June	1,419	.92	1,305
-1952	July	1,263	.88	1,111
	Aug.	1,296	.83	1,076
	Sept.	1,321	.79	1,044
	Oct.	1,234	.74	913
	Nov.	1,172	.69	809
	Dec.	1,303	.67	873
	Total	15,413	.83	12,838

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	1,198	0.66	791
	Feb.	1,020	.81	826
	Mar.	947	.88	833
	Apr.	808	.91	735
	May	953	.90	858
	June	956	.90	860
-1953	July	1,093	.87	951
	Aug.	1,056	.84	887
	Sept.	823	.83	683
	Oct.	634	.84	533
	Nov.	527	.85	448
	Dec.	634	.85	539
	Total	10,649	.84	8,944
	Jan.	797	.84	669
	Feb.	661	.83	549
	Mar.	782	.84	657
	Apr.	864	.84	726
	May	1,015	.89	903
	June	883	.92	812
-1954	July	1,000	.91	910
	Aug.	982	.91	894
	Sept.	754	.91	686
	Oct.	636	.92	585
	Nov.	638	.92	587
	Dec.	659	.92	606
	Total	9,671	.89	8,584
	Jan.	734	.93	683
	Feb.	598	.94	562
	Mar.	733	.96	704
	Apr.	758	.97	735
	May	792	.99	784
	June	866	1.03	892
-1955	July	963	1.07	1,030
	Aug.	849	1.06	900
	Sept.	694	1.04	722
	Oct.	499	1.06	529
	Nov.	369	1.09	402
	Dec.	286	1.09	312
	Total	8,141	1.01	8,255
	Jan.	317	1.10	349
	Feb.	365	1.10	402
	Mar.	628	1.10	691
	Apr.	684	1.09	746
	May	671	1.07	718
	June	787	1.09	858
-1956	July	865	1.10	952
	Aug.	823	1.09	897
	Sept.	634	1.12	710
	Oct.	486	1.08	525
	Nov.	321	1.11	356
	Dec.	288	1.14	328
	Total	6,869	1.10	7,532
	Jan.	243	1.15	279
	Feb.	349	1.12	391
	Mar.	589	1.09	642
	Apr.	731	1.06	775
	May	645	1.06	684
	June	783	1.05	822
-1957	July	890	1.03	917
	Aug.	817	1.01	825
	Sept.	661	.99	654
	Oct.	503	1.00	503
	Nov.	781	1.00	781
	Dec.	1,005	1.01	1,015
	Total	7,997	1.04	8,288
	Jan.	1,285	.97	1,246
	Feb.	565	.93	525
	Mar.	1,345	.89	1,197
	Apr.	1,333	.87	1,160
	May	1,013	.85	861
	June	854	.84	717
-1958	July	930	.84	781
	Aug.	867	.82	711
	Sept.	714	.81	578
	Oct.	610	.82	500
	Nov.	623	.82	511
	Dec.	753	.83	625
	Total	10,892	.86	9,412

To obtain mg/l multiply T/AF by 735.

Table 16

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River below Parker Dam, Arizona-California

Units-1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	677	0.82	555
	Feb.	593	.82	486
	Mar.	690	.82	566
	Apr.	832	.83	691
	May	706	.86	607
	June	797	.87	693
-1959	July	962	.84	808
	Aug.	873	.79	690
	Sept.	682	.80	546
	Oct.	558	.83	463
	Nov.	405	.84	340
	Dec.	411	.83	341
	Total	8,186	.83	6,786
	Jan.	428	.82	351
	Feb.	474	.81	384
	Mar.	760	.81	616
	Apr.	810	.85	689
	May	740	.86	636
	June	879	.88	774
-1960	July	986	.87	858
	Aug.	868	.88	764
	Sept.	640	.87	557
	Oct.	490	.86	421
	Nov.	397	.89	353
	Dec.	322	.91	293
	Total	7,794	.86	6,696
	Jan.	379	.91	345
	Feb.	453	.90	408
	Mar.	742	.90	668
	Apr.	725	.90	653
	May	705	.92	649
	June	822	.92	756
-1961	July	900	.91	819
	Aug.	710	.91	646
	Sept.	606	.90	545
	Oct.	412	.90	371
	Nov.	319	.94	300
	Dec.	202	.94	190
	Total	6,975	.91	6,350
	Jan.	334	.93	310
	Feb.	374	.92	344
	Mar.	692	.92	637
	Apr.	756	1/.94	711
	May	686	1/.95	652
	June	778	.97	755
-1962	July	882	.95	838
	Aug.	821	.97	796
	Sept.	644	.95	612
	Oct.	471	.96	452
	Nov.	434	.96	417
	Dec.	287	1.00	286
	Total	7,159	1/.95	6,810
	Jan.	350	.99	346
	Feb.	467	.98	458
	Mar.	735	.97	713
	Apr.	690	.97	670
	May	708	.95	672
	June	840	.93	781
-1963	July	933	.90	840
	Aug.	819	.89	729
	Sept.	630	.87	561
	Oct.	438	.87	381
	Nov.	334	.88	294
	Dec.	307	.89	273
	Total	7,251	.93	6,718
	Jan.	363	.90	327
	Feb.	479	.90	432
	Mar.	640	.89	570
	Apr.	652	.89	581
	May	598	.91	544
	June	742	.93	690
-1964	July	864	.94	812
	Aug.	795	.94	747
	Sept.	589	.92	542
	Oct.	409	.96	394
	Nov.	275	.96	264
	Dec.	245	1.00	244
	Total	6,651	.92	6,147
	Jan.	290	0.98	284
	Feb.	423	.99	419
	Mar.	634	1.00	634
	Apr.	581	1.01	587
	May	604	1.06	640
	June	710	1.05	746
-1965	July	846	1.06	897
	Aug.	867	1.06	919
	Sept.	599	1.05	629
	Oct.	385	1.08	416
	Nov.	220	1.08	237
	Dec.	197	1.05	207
	Total	6,356	1.04	6,615
	Jan.	177	0.82	145
	Feb.	413	1.04	430
	Mar.	604	1.08	652
	Apr.	729	1.06	773
	May	699	1.05	734
	June	790	1.03	814
-1966	July	901	1.03	928
	Aug.	852	1.02	869
	Sept.	585	1.00	585
	Oct.	357	1.00	357
	Nov.	256	1.00	256
	Dec.	320	1.00	320
	Total	6,683	1.03	6,863
	Jan.	306	1.00	306
	Feb.	431	1.00	431
	Mar.	677	1.03	697
	Apr.	608	.96	584
	May	648	.97	629
	June	726	.90	653
-1967	July	835	.87	726
	Aug.	749	.90	674
	Sept.	490	.90	441
	Oct.	435	.92	400
	Nov.	247	.93	230
	Dec.	170	.93	158
	Total	6,322	.94	5,929
	Jan.	351	.93	326
	Feb.	450	.92	414
	Mar.	680	.92	626
	Apr.	700	.94	658
	May	626	.92	576
	June	722	.96	693
-1968	July	779	.94	732
	Aug.	725	.95	688
	Sept.	585	.94	550
	Oct.	404	.98	396
	Nov.	309	.96	297
	Dec.	312	.95	296
	Total	6,643	.94	6,252

To obtain mg/l multiply T/AF by 735.

Table 16
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River below Parker Dam, Arizona – California
(Annual Summary)

Units – 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	14,749	1.02	750	15,052
1942	15,159	.96	709	14,662
1943	12,079	.90	661	10,858
1944	13,842	.91	669	12,596
1945	12,033	.90	660	10,808
1946	10,141	.89	658	9,075
1947	10,663	.91	670	9,725
1948	12,651	.88	647	11,144
1949	13,060	.82	603	10,716
1950	10,473	.84	618	8,801
1951	8,672	.88	645	7,612
1952	15,413	.83	612	12,838
1953	10,649	.84	617	8,944
1954	9,671	.89	652	8,584
1955	8,141	1.01	745	8,255
1956	6,869	1.10	806	7,532
1957	7,997	1.04	762	8,288
1958	10,892	.86	635	9,412
1959	8,186	.83	609	6,786
1960	7,794	.86	631	6,696
1961	6,975	.91	669	6,350
1962	7,159	1/ .95	699	6,810
1963	7,251	.93	681	6,718
1964	6,651	.92	679	6,147
1965	6,356	1.04	765	6,615
1966	6,683	1.03	755	6,863
1967	6,322	.94	689	5,929
1968	6,643	.94	692	6,252
Total	273,210			250,068
Average	9,758	.92	673	8,931

1/ Partially estimated.

Records furnished by Metropolitan Water District of Southern California

Table 17

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Imperial Dam, Arizona - California

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	642	1.10	706
	Feb.	535	1.15	615
	Mar.	743	.90	669
	Apr.	562	1.04	584
	May	1,150	1.11	1,277
	June	1,605	1.21	1,942
-1941	July	965	1.17	1,129
	Aug.	1,192	1.09	1,299
	Sept.	1,444	.99	1,430
	Oct.	1,505	1.02	1,535
	Nov.	1,671	1.02	1,704
	Dec.	2,010	1.04	2,090
	Total	14,024	1.07	14,980
	Jan.	1,876	1.08	2,026
	Feb.	1,590	1.09	1,733
	Mar.	1,476	1.09	1,609
	Apr.	1,080	1.11	1,199
	May	1,524	1.10	1,676
	June	1,465	1.11	1,626
-1942	July	1,199	1.11	1,331
	Aug.	844	1.09	920
	Sept.	742	1.11	824
	Oct.	761	1.08	822
	Nov.	981	1.03	1,010
	Dec.	1,176	.97	1,141
	Total	14,714	1.08	15,917
	Jan.	1,011	.94	950
	Feb.	729	.92	671
	Mar.	846	.95	804
	Apr.	802	.96	770
	May	842	.98	825
	June	876	.98	858
-1943	July	972	.95	923
	Aug.	910	.94	855
	Sept.	917	.94	862
	Oct.	1,094	.94	1,028
	Nov.	1,124	.93	1,045
	Dec.	1,222	.89	1,088
	Total	11,345	.94	10,679
	Jan.	1,209	.89	1,076
	Feb.	1,216	.94	1,143
	Mar.	1,289	.97	1,250
	Apr.	1,126	1.00	1,126
	May	1,055	1.01	1,066
	June	900	1.02	918
-1944	July	920	.99	911
	Aug.	1,041	.97	1,010
	Sept.	1,041	.94	979
	Oct.	1,123	.92	1,033
	Nov.	1,142	.89	1,016
	Dec.	1,143	.89	1,017
	Total	13,205	.95	12,545
	Jan.	1,160	.99	1,137
	Feb.	1,047	.97	1,016
	Mar.	1,193	.97	1,157
	Apr.	947	.98	928
	May	905	1.00	905
	June	860	.99	851
-1945	July	817	.96	784
	Aug.	718	.94	675
	Sept.	745	.92	685
	Oct.	912	.88	803
	Nov.	1,011	.89	900
	Dec.	1,075	.93	1,000
	Total	11,390	.95	10,841
	Jan.	1,008	.94	948
	Feb.	1,005	.92	925
	Mar.	927	.94	871
	Apr.	759	.96	729
	May	786	.98	770
	June	658	.99	651
-1946	July	719	.97	697
	Aug.	666	.94	626
	Sept.	639	.95	607
	Oct.	707	.97	686
	Nov.	757	.96	727
	Dec.	855	.94	804
	Total	9,486	.95	9,041
	Jan.	933	0.95	886
	Feb.	872	.95	828
	Mar.	934	.98	915
	Apr.	737	1.02	752
	May	827	1.01	835
	June	787	1.02	803
-1947	July	743	1.01	750
	Aug.	830	.99	822
	Sept.	733	1.00	733
	Oct.	753	.95	715
	Nov.	851	.90	766
	Dec.	1,041	.87	906
	Total	10,041	.97	9,711
	Jan.	1,106	.97	1,073
	Feb.	1,135	.94	1,067
	Mar.	1,092	.95	1,037
	Apr.	1,007	.94	947
	May	1,051	.95	998
	June	916	.95	870
-1948	July	1,003	.95	953
	Aug.	906	.94	852
	Sept.	871	.91	793
	Oct.	901	.89	802
	Nov.	945	.86	813
	Dec.	1,103	.94	1,037
	Total	12,036	.93	11,242
	Jan.	1,237	.92	1,138
	Feb.	1,183	.88	1,041
	Mar.	1,226	.88	1,079
	Apr.	1,084	.91	986
	May	927	.92	853
	June	871	.93	810
-1949	July	860	.92	791
	Aug.	934	.88	822
	Sept.	996	.86	857
	Oct.	1,103	.83	915
	Nov.	1,000	.93	930
	Dec.	1,146	.77	882
	Total	12,567	.88	11,104
	Jan.	1,088	.89	968
	Feb.	994	.87	865
	Mar.	1,169	.88	1,029
	Apr.	936	.90	842
	May	1,002	.91	912
	June	841	.89	748
-1950	July	822	.89	732
	Aug.	758	.88	667
	Sept.	643	.87	559
	Oct.	603	.94	567
	Nov.	510	.95	485
	Dec.	540	.95	513
	Total	9,906	.90	8,887
	Jan.	558	.95	530
	Feb.	498	.96	478
	Mar.	635	.96	610
	Apr.	744	.96	714
	May	606	.99	600
	June	703	.98	689
-1951	July	820	.98	804
	Aug.	853	.95	810
	Sept.	697	.93	648
	Oct.	682	.96	655
	Nov.	559	.97	542
	Dec.	698	.98	684
	Total	8,053	.96	7,764
	Jan.	1,058	.95	1,005
	Feb.	1,107	.96	1,063
	Mar.	1,424	.92	1,310
	Apr.	1,279	.97	1,241
	May	1,345	1.00	1,345
	June	1,309	.99	1,296
-1952	July	1,182	.97	1,147
	Aug.	1,178	.92	1,084
	Sept.	1,219	.87	1,061
	Oct.	1,240	.84	1,042
	Nov.	1,176	.78	917
	Dec.	1,298	.75	974
	Total	14,815	.91	13,485
	Jan.	1,216	0.77	936
	Feb.	1,022	.89	910
	Mar.	911	.95	865
	Apr.	756	1.01	764
	May	856	1.01	865
	June	811	1.00	811
-1953	July	980	.96	941
	Aug.	931	.95	884
	Sept.	776	.93	722
	Oct.	644	.96	618
	Nov.	522	.97	506
	Dec.	620	.95	589
	Total	10,045	.94	9,411
	Jan.	783	.94	736
	Feb.	661	.94	621
	Mar.	723	.94	680
	Apr.	773	.94	727
	May	929	1.05	975
	June	804	1.03	828
-1954	July	885	1.01	894
	Aug.	887	1.03	914
	Sept.	719	1.02	733
	Oct.	620	1.03	639
	Nov.	602	1.02	614
	Dec.	644	1.03	663
	Total	9,030	1.00	9,024
	Jan.	739	1.00	739
	Feb.	593	1.03	611
	Mar.	678	1.07	725
	Apr.	716	1.09	780
	May	729	1.13	824
	June	746	1.20	895
-1955	July	882	1.21	1,067
	Aug.	811	1.18	957
	Sept.	638	1.17	746
	Oct.	499	1.20	599
	Nov.	379	1.24	470
	Dec.	298	1.29	384
	Total	7,708	1.14	8,797
	Jan.	298	1.31	390
	Feb.	344	1.24	427
	Mar.	546	1.24	677
	Apr.	646	1.23	795
	May	594	1.26	748
	June	666	1.25	833
-1956	July	753	1.25	941
	Aug.	717	1.22	875
	Sept.	583	1.24	723
	Oct.	479	1.24	594
	Nov.	343	1.28	439
	Dec.	297	1.30	386
	Total	6,266	1.25	7,828
	Jan.	258	1.36	351
	Feb.	314	1.32	414
	Mar.	520	1.23	640
	Apr.	667	1.18	787
	May	581	1.19	691
	June	651	1.19	775
-1957	July	794	1.22	969
	Aug.	759	1.08	820
	Sept.	616	1.12	690
	Oct.	511	1.16	593
	Nov.	695	1.14	792
	Dec.	978	1.10	1,076
	Total	7,344	1.17	8,598
	Jan.	1,299	1.05	1,364
	Feb.	637	1.07	682
	Mar.	1,253	1.06	1,328
	Apr.	1,280	1.02	1,306
	May	1,016	1.00	1,016
	June	769	1.01	777
-1958	July	812	.96	780
	Aug.	802	.97	778
	Sept.	655	.97	635
	Oct.	624	1.01	630
	Nov.	592	1.00	592
	Dec.	761	.97	738
	Total	10,500	1.01	10,626

To obtain mg/l multiply T/AF by 735.

Table 17

Colorado River Basin

Historical Flow and Quality of Water Data

Colorado River at Imperial Dam, Arizona - California

Units - 1000

Year	Month	Flow (A.F.)	Concentration (T./A.F.)	T.D.S. (Tons)
	Jan.	674	0.99	667
	Feb.	592	.99	586
	Mar.	618	1.02	630
	Apr.	770	1.01	778
	May	646	1.05	678
	June	679	1.03	699
-1959	July	824	.99	816
	Aug.	821	1.04	854
	Sept.	644	1.04	670
	Oct.	565	1.03	582
	Nov.	421	1.04	438
	Dec.	441	1.01	445
	Total	7,695	1.02	7,843
	Jan.	449	1.02	458
	Feb.	436	1.00	436
	Mar.	651	.99	644
	Apr.	762	.99	754
	May	650	1.07	696
	June	736	1.07	788
-1960	July	845	1.07	904
	Aug.	777	1.06	824
	Sept.	606	1.09	661
	Oct.	481	1.10	529
	Nov.	360	1.14	410
	Dec.	354	1.15	407
	Total	7,107	1.06	7,511
	Jan.	342	1.18	404
	Feb.	400	1.15	460
	Mar.	648	1.10	713
	Apr.	666	1.08	719
	May	618	1.14	705
	June	691	1.08	746
-1961	July	755	1.09	823
	Aug.	671	1.12	752
	Sept.	541	1.14	617
	Oct.	427	1.10	470
	Nov.	312	1.12	349
	Dec.	222	1.18	262
	Total	6,293	1.12	7,020
	Jan.	337	1.11	374
	Feb.	304	1.14	347
	Mar.	597	1.06	633
	Apr.	689	1.06	730
	May	619	1.11	688
	June	648	1.12	725
-1962	July	741	1.11	822
	Aug.	730	1.12	818
	Sept.	593	1.11	658
	Oct.	458	1.15	527
	Nov.	439	1.16	509
	Dec.	303	1.18	358
	Total	6,458	1.11	7,189
	Jan.	337	1.14	384
	Feb.	393	1.11	436
	Mar.	615	1.10	676
	Apr.	647	1.09	705
	May	602	1.09	656
	June	691	1.06	733
-1963	July	775	1.04	806
	Aug.	757	1.02	772
	Sept.	595	1.04	619
	Oct.	461	1.08	498
	Nov.	340	1.12	381
	Dec.	309	1.13	350
	Total	6,522	1.08	7,016
	Jan.	337	1.12	377
	Feb.	415	1.07	444
	Mar.	562	1.06	595
	Apr.	609	1.07	652
	May	530	1.10	583
	June	576	1.15	663
-1964	July	719	1.09	784
	Aug.	679	1.09	740
	Sept.	539	1.14	615
	Oct.	396	1.22	483
	Nov.	281	1.26	354
	Dec.	257	1.27	326
	Total	5,900	1.12	6,616
	Jan.	271	1.26	341
	Feb.	332	1.26	418
	Mar.	548	1.20	658
	Apr.	566	1.15	651
	May	548	1.22	669
	June	558	1.22	680
-1965	July	709	1.26	893
	Aug.	737	1.28	943
	Sept.	540	1.31	708
	Oct.	400	1.29	516
	Nov.	257	1.33	342
	Dec.	237	1.22	290
	Total	5,703	1.25	7,109
	Jan.	203	1.13	229
	Feb.	334	1.21	404
	Mar.	517	1.21	626
	Apr.	622	1.22	758
	May	576	1.24	715
	June	637	1.31	835
-1966	July	729	1.20	874
	Aug.	733	1.18	865
	Sept.	532	1.21	643
	Oct.	389	1.23	478
	Nov.	263	1.28	337
	Dec.	314	1.18	369
	Total	5,849	1.22	7,133
	Jan.	301	1.21	364
	Feb.	369	1.16	428
	Mar.	593	1.12	664
	Apr.	558	1.15	642
	May	550	1.16	638
	June	595	1.16	690
-1967	July	673	1.08	727
	Aug.	672	1.09	732
	Sept.	450	1.16	522
	Oct.	412	1.12	461
	Nov.	268	1.22	327
	Dec.	174	1.35	235
	Total	5,615	1.15	6,430
	Jan.	342	1.18	404
	Feb.	366	1.10	403
	Mar.	566	1.10	623
	Apr.	622	1.09	678
	May	532	1.18	628
	June	580	1.10	638
-1968	July	625	1.14	713
	Aug.	609	1.16	706
	Sept.	494	1.17	578
	Oct.	399	1.21	483
	Nov.	297	1.25	371
	Dec.	309	1.25	386
	Total	5,741	1.15	6,611

To obtain mg/l multiply T/AF by 735.

Table 17
Colorado River Basin
Historical Flow and Quality of Water Data
Colorado River at Imperial Dam, Arizona — California
(Annual Summary)

Units – 1000

Year	Flow (A.F.)	Concentration (T./A.F.)	Concentration (Mg./1)	T.D.S. (Tons)
1941	14,024	1.07	785	14,980
1942	14,714	1.08	795	15,917
1943	11,345	.94	692	10,679
1944	13,205	.95	698	12,545
1945	11,390	.95	700	10,841
1946	9,486	.95	701	9,041
1947	10,041	.97	711	9,711
1948	12,036	.93	687	11,242
1949	12,567	.88	649	11,104
1950	9,906	.90	659	8,887
1951	8,053	.96	709	7,764
1952	14,815	.91	669	13,485
1953	10,045	.94	689	9,411
1954	9,030	1.00	735	9,024
1955	7,708	1.14	839	8,797
1956	6,266	1.25	918	7,828
1957	7,344	1.17	860	8,598
1958	10,500	1.01	744	10,626
1959	7,695	1.02	749	7,843
1960	7,107	1.06	777	7,511
1961	6,293	1.12	820	7,020
1962	6,458	1.11	818	7,189
1963	6,522	1.08	791	7,016
1964	5,900	1.12	824	6,616
1965	5,703	1.25	916	7,109
1966	5,849	1.22	896	7,133
1967	5,615	1.15	842	6,430
1968	5,741	1.15	846	6,611
Total	255,358			260,958
Average	9,120	1.02	751	9,320

Table 18

Summary of Historical and Present Modified Quality of Water and Anticipated Effects of Future Developments at Eighteen Stations

Colorado River Basin

(Units: 1,000 except concentrations)

Station	Historical condition				Present modified condition						Effects of future developments									
													Zero pickup				T.D.S. pickup at 2T/A			
	Flow (AF)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/l)	Flow adjustment (AF)	Flow (AF)	T.D.S. adjustment (T)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/l)	Flow adjustment (AF)	Flow (AF)	T.D.S. adjustment (T)	T.D.S. (T)	Concentration (T/AF)	Concentration (mg/l)	T.D.S. adjustment (T)	T.D.S. (T)	(T/AF)	(mg/l)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Green River near Green River, Wyoming	1,282	535	0.42	307	-24	1,258	+13	548	.44	320	-231	1,027	-13	535	.52	383	+100	648	.63	464
Green River near Greendale, Utah	1,562	873	0.56	411	-7	1,555	+42	915	.59	432	-249	1,306	-13	902	.69	508	+100	1,015	.78	571
Duchesne River near Randlett, Utah	448	411	0.92	674	-21	427	-1	410	.96	706	-206	221	-27	383	1.73	1,270	-11	399	1.81	1,330
Green River at Green River, Utah	4,123	2,549	0.62	454	-60	4,063	+55	2,604	.64	471	-573	3,490	-50	2,554	.73	538	+116	2,720	.78	573
San Rafael River near Green River, Utah	93	210	2.3	1,660	-15	78	+2	212	2.7	2,000	-5	73	0	212	2.9	2,130	-8	204	2.8	2,050
Colorado River near Glenwood Springs, Colorado	1,608	595	0.37	272	-203	1,405	-11	584	.42	306	-277	1,128	-24	560	.50	365	-24	560	.50	365
Colorado River near Cameo, Colorado	2,758	1,523	0.55	406	-235	2,523	-5	1,518	.60	442	-475	2,048	-27	1,491	.73	535	+11	1,529	.75	549
Gunnison River near Grand Junction, Colorado	1,697	1,451	0.86	628	-24	1,673	+20	1,471	.88	646	-69	1,604	0	1,471	.92	674	+65	1,536	.96	704
Colorado River near Cisco, Utah	4,925	4,158	0.84	621	-325	4,600	+44	4,202	.91	671	-769	3,831	-51	4,151	1.08	796	+104	4,306	1.12	826
San Juan River near Archuleta, New Mexico	909	196	0.22	158	+6	916	+12	208	.23	167	-618	298	-137	71	.24	175	-137	71	.24	175
San Juan River near Bluff, Utah	1,612	962	0.6	439	-24	1,588	+32	994	.63	460	-488	1,100	+7	1,001	.91	669	+384	1,378	1.25	921
Colorado River at Lees Ferry, Arizona	10,642	7,997	0.75	552	-434	10,208	+600	8,597	.84	619	-1,892	8,316	-211	8,386	1.01	741	+478	9,075	1.09	802
Colorado River near Grand Canyon, Arizona	10,927	9,134	0.84	614	-434	10,493	+600	9,734	.93	682	-1,892	8,601	-211	9,523	1.11	814	+478	10,212	1.19	873
Virgin River at Littlefield, Arizona	151	346	2.29	1,680	0	151	0	346	2.29	1,680	-48	103	-2	344	3.34	2,450	+12	358	3.48	2,550
Colorado River below Hoover Dam, Ariz.-Nev.	10,682	9,991	0.94	687	-563	10,119	+467	10,458	1.03	760	-2,180	7,939	-213	10,245	1.29	948	+490	10,948	1.38	1,010
Colorado River above Parker Dam, Ariz.-Calif.	10,277	9,419	0.92	673	-446	9,833	+529	9,948	1.01	744	-2,207	7,626	-236	9,712	1.27	936	+507	10,455	1.37	1,010
Colorado River below Parker Dam, Ariz.-Calif.	9,758	8,931	0.92	673	-1,107	8,651	-179	8,752	1.01	744	-2,008	6,643	-292	8,460	1.27	936	+355	9,107	1.37	1,010
Colorado River at Imperial Dam, Ariz.-Calif.	9,120	9,320	1.02	751	-1,273	7,847	-90	9,230	1.18	865	-2,147	5,700	-292	8,938	1.57	1,150	+477	9,707	1.70	1,250

Table 19
Projects depleting Colorado River water

Project and state	New depletion (ac.-ft.)	New irrigation land (acres)
Above the gage Green River at Green River, Wyoming		
Seedskadee, Wyoming	145,000	58,000
Westvaco and others, Wyoming	86,000	1/
Between the above gage and the gage Green River near Greendale, Utah		
Lyman, Wyoming	10,000	0
Utah Power & Light and others, Wyoming	8,000	1/
Above the gage Duchesne River near Randlett, Utah		
Central Utah Project, Utah		
Bonneville Unit	166,000	2/
Upalco Unit	10,000	0
Uintah Unit	30,000	7,800
Between the gages Green River near Greendale, Utah, and Duchesne River near Randlett, Utah, and the gage Green River at Green River, Utah		
Four County, Colorado	40,000	2/
Hayden Steamplant, Colorado	12,000	1/
Cheyenne-Laramie, Wyoming	24,000	2/
Savery-Pot Hook, Colorado-Wyoming	27,000	17,920
Central Utah Project		
Jensen Unit	15,000	440
Above the gage San Rafael near Green River, Utah		
Utah Power & Light, Emery County, Utah	5,000	1/
Above the gage Colorado River near Glenwood Springs, Colorado		
Denver-Englewood, Colorado	216,000	2/
Green Mountain M&I, Colorado	12,000	1/
Homestake Project, Colorado	49,000	2/
Between the above gage and gage Colorado River near Cameo, Colorado		
Independence Pass Expansion, Colorado	14,000	2/
Fryingpan-Arkansas, Colorado	70,000	2/
Ruedi M&I, Colorado	38,000	1/
West Divide, Colorado	76,000	19,000
Above the gage Gunnison River near Grand Junction, Colorado		
Fruitland Mesa, Colorado	28,000	15,870
Bostwick Park, Colorado	4,000	1,610
Dallas Creek, Colorado	37,000	15,000
Between the gages Colorado River near Cameo, Colorado, and Gunnison River near Grand Junction, Colorado, and the gage Colorado River near Cisco, Utah		
Dolores, Colorado	3/140,000	32,000
San Miguel, Colorado	85,000	26,000
Above the gage San Juan River near Archuleta, New Mexico		
San Juan-Chama, New Mexico	110,000	2/
Navajo Indian Irrigation, New Mexico	4/508,000	110,000
Between the above gage and the gage San Juan River near Bluff, Utah		
Animas-La Plata, Colorado-New Mexico	146,000	46,500
Expansion Hogback, New Mexico	10,000	0
Utah Construction Co., New Mexico	25,000	1/
Return flow--Dolores and Navajo Indian Irrigation, Colorado and New Mexico	-311,000	3/ 4/
Between the gages Green River at Green River, Utah; San Rafael River near Green River, Utah; Colorado River near Cisco, Utah; and San Juan River near Bluff, Utah; and the gage Colorado River at Lees Ferry, Arizona		
Resources, Inc., Utah	102,000	1/
Arizona M&I, Arizona	35,000	1/
Salvage	-80,000	
Subtotal Upper Basin	1,892,000	350,140
Between the above gage and the gage Colorado River near Grand Canyon, Arizona	0	0
Above the gage Virgin River at Littlefield, Arizona		
Dixie Project, Utah	5/48,000	6,900
Between the gages Colorado River near Grand Canyon, Arizona, and Virgin River at Littlefield, Arizona, and the gage Colorado River below Hoover Dam, Arizona-Nevada		
Southern Nevada Water Project, Nevada	6/240,000	1/
Between the above gage and the gage Colorado River below Parker Dam, Arizona-California		
Fort Mohave and Chemehuevi Indian, Arizona, California, and Nevada	83,000	20,900
Central Arizona, Arizona 7/	433,000	
Reduced Metropolitan Water District Diversions 7/	-433,000	
Kingman, Arizona	18,000	1/
Mohave Valley I&D District, Arizona	6,000	1/
Lake Havasu I&D District, Arizona	7,000	1/
Salvage	-87,000	
Reduced Metropolitan Water District Diversions 7/	-199,000	
Between the above gage and the gage Colorado River at Imperial Dam, Arizona-Colorado		
Colorado River Indian, Arizona-California	243,000	60,840
Salvage	-104,000	
Subtotal Lower Basin	255,000	88,640
Total Colorado River	2,147,000	438,780

1/ In-basin depletion without irrigated lands.
2/ Transmountain diversion.
3/ In-basin transfer from Dolores River drainage to the San Juan River drainage--estimated 53,000-acre-foot return flow to the San Juan River.
4/ Diversions at Navajo Reservoir, estimated 258,000-acre-foot return flow to the San Juan River below the gage near Archuleta, New Mexico.
5/ Includes a transmountain diversion to Great Basin.
6/ Pending full development, the Mohave Thermal Plant will use part of this water which will be diverted below Hoover Dam.
7/ The Central Arizona Project diversions will vary, depending on the depletions by other projects on the river. Under present modified conditions maximum diversions to Central Arizona could be 2,172,000 acre-feet but with full depletions by the projects tabulated, the maximum diversions would be 433,000 acre-feet. Also with full depletions by the projects tabulated, the diversions to the Metropolitan Water District of Southern California would be reduced to an annual 550,000 acre-feet from its present diversions of 1,182,000 acre-feet. This will provide 199,000 acre-feet needed to develop the other tabulated projects in the Lower Basin in addition to the 433,000 acre-feet delivered to the Central Arizona Project.

Table 20

Units: 1,000[1/] Dissolved constituent loads of Green River at Green River Utah

Calendar year	Mean discharge (a.f.)	Ionic loads in tons equivalent: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	SAR[2/]	Kx10^6 at 25° C. 3/	T.D.S. Tons	T.D.S. mg/l
1941	4,608	21	14	20	21	28	6	1.9	*775	3,271	522
1942	4,622	20	13	17	20	25	5	1.7	*715	2,989	475
1943	4,294	17	11	15	18	21	4	1.6	*670	2,565	439
1944	4,417	18	11	16	20	21	4	1.6	682	2,582	430
1945	4,260	18	11	14	20	20	4	1.5	679	2,558	441
1946	3,519	15	9	12	17	16	4	1.6	689	2,148	449
1947	5,523	21	13	17	24	23	5	1.4	615	2,991	398
1948	3,928	16	10	13	17	18	4	1.5	647	2,270	425
1949	5,129	22	13	17	24	23	5	1.5	671	3,039	435
1950	5,476	24	14	17	27	24	5	1.4	669	3,223	433
1951	4,738	20	12	15	22	22	4	1.3	656	2,847	442
1952	6,712	30	18	22	33	31	6	1.4	692	4,172	457
1953	3,334	15	10	13	16	18	4	1.6	730	2,225	491
1954	2,638	12	7	11	12	15	3	1.7	755	1,807	503
1955	2,791	12	7	11	12	14	3	1.6	695	1,733	456
1956	4,021	15	9	11	16	15	4	1.3	575	2,045	374
1957	5,808	22	13	17	23	24	5	1.3	587	3,060	387
1958	4,212	16	11	14	18	19	4	1.5	640	2,421	422
1959	2,884	12	7	11	12	15	3	1.7	696	1,802	459
1960	2,864	11	6	10	12	13	3	1.5	604	1,645	422
1961	2,265	10	6	9	10	12	3	1.6	707	1,450	471
1962	5,601	21	12	17	22	23	4	1.4	621	3,077	404
1963	1,576	7	5	8	7	11	2	2.2	854	1,241	579
1964	3,242	14	8	11	14	15	3	1.6	686	2,044	463
1965	5,211	22	14	19	22	28	5	1.7	721	3,412	481
1966	2,966	13	10	13	13	20	3	1.9	820	2,260	560
1967	4,227	21	13	18	18	30	4	1.8	811	3,257	566
1968	4,589	20	13	18	19	28	4	1.7	741	3,225	517
Total	115,455	485	300	406	509	572	113	-	-	71,359	-
Mean	4,123	17	11	14	18	20	4	1.6	684	2,549	454

Table 21

Units: 1,000[1/] Dissolved constituent loads of Colorado River near Cisco, Utah

Calendar year	Mean discharge (a.f.)	Ionic loads in tons equivalent: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	SAR[2/]	Kx10^6 at 25° C. 3/	T.D.S. Tons	T.D.S. mg/l
1941	7,067	35	22	34	24	51	15	1.8	*900	5,653	588
1942	7,098	34	22	33	24	49	15	1.8	*870	5,483	568
1943	5,214	28	18	27	19	41	13	1.9	*960	4,498	634
1944	5,840	30	16	26	22	37	14	1.7	848	4,336	546
1945	5,504	28	16	25	21	36	14	1.8	867	4,210	562
1946	4,058	24	15	22	16	34	11	2.0	1,010	3,680	667
1947	6,258	32	17	27	22	39	14	1.7	821	4,587	539
1948	6,291	33	18	27	24	38	15	1.6	826	4,636	542
1949	6,338	32	18	29	24	39	16	1.8	859	4,783	555
1950	4,074	24	15	24	16	33	14	2.1	1,040	3,823	690
1951	3,986	23	14	23	14	32	13	2.1	1,010	3,758	693
1952	7,718	34	19	27	26	39	15	1.4	724	5,063	482
1953	4,062	24	15	25	15	34	15	2.2	1,060	3,944	714
1954	2,293	19	13	22	10	30	13	3.1	1,570	3,299	1,060
1955	3,185	21	13	22	12	30	14	2.4	1,180	3,420	789
1956	3,568	22	13	21	13	30	13	2.1	1,060	3,428	706
1957	8,888	42	18	31	29	44	19	1.4	721	5,602	463
1958	6,044	29	15	26	19	36	16	1.6	814	4,348	529
1959	3,214	22	13	22	12	31	13	2.4	1,200	3,481	796
1960	4,002	23	13	21	14	31	13	1.9	964	3,493	642
1961	3,395	24	12	22	12	32	13	2.2	1,150	3,556	770
1962	6,576	33	14	26	22	35	15	1.6	764	4,484	501
1963	2,585	21	11	21	10	30	13	2.8	1,390	3,384	962
1964	3,433	22	13	21	13	28	14	2.2	1,110	3,639	779
1965	6,722	32	17	28	22	37	17	1.7	807	4,892	535
1966	3,163	20	13	22	12	30	13	2.4	1,170	3,471	807
1967	3,146	22	12	24	13	31	14	2.7	1,210	3,602	842
1968	4,185	23	15	23	15	32	14	2.1	991	3,869	680
Total	137,907	756	430	701	495	989	398	-	-	116,422	-
Mean	4,925	27	15	25	18	35	14	1.9	934	4,158	620

1/ Escept SAR, specific conductance, and mg/l. *Correlated

2/ Sodium adsorption ratio

3/ Specific conductance.

Mg/l of ion = 735 x Ionic load x atomic st. of ion ÷ discharge (af).

Table 22

Units: $1,000^{1/}$ Dissolved constituent loads of San Juan River near Bluff, Utah

Calendar year	Mean discharge (a.f.)	Ionic loads in tons equivalent: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	SAR 2/	$Kx10^6$ at 25° C. 3/	T.D.S. Tons	T.D.S. mg/1
1941	4,899	23	8	12	18	23	2	1.1	608	2,625	394
1942	2,247	10	5	5	8	11	1	1.0	582	1,185	388
1943	1,494	8	4	5	6	9	1	1.3	699	959	472
1944	2,291	10	4	5	8	10	1	.9	537	1,101	353
1945	1,588	8	4	5	6	9	1	1.2	647	935	433
1946	887	6	3	4	4	7	1	1.5	818	681	564
1947	1,677	9	4	6	6	11	1	1.5	694	1,087	476
1948	2,140	9	3	5	7	9	1	1.0	498	976	335
1949	2,487	11	4	5	8	11	1	1.0	516	1,168	345
1950	854	5	3	3	3	6	1	1.3	724	579	498
1951	691	4	2	3	3	6	1	1.6	812	544	579
1952	2,554	10	4	5	8	10	1	.9	488	1,156	333
1953	967	6	3	4	4	7	1	1.5	754	701	533
1954	1,011	6	3	4	4	8	1	1.6	803	779	566
1955	910	5	2	4	4	7	1	1.6	769	667	539
1956	838	4	2	3	3	5	1	1.3	673	535	469
1957	2,909	13	5	7	9	13	2	1.2	555	1,498	378
1958	2,298	9	4	5	7	10	1	1.0	527	1,116	357
1959	712	5	2	4	3	6	1	1.8	853	578	597
1960	1,607	7	3	5	5	8	1	1.2	563	847	387
1961	1,264	7	3	5	5	8	1	1.4	702	336	486
1962	1,480	7	2	5	4	8	1	1.4	637	877	436
1963	579	4	2	3	2	7	1	2.1	1,110	635	806
1964	795	5	2	4	3	8	1	2.1	979	781	722
1965	2,546	10	5	6	8	13	1	1.2	589	1,379	398
1966	1,548	7	4	5	5	10	1	1.4	683	996	473
1967	791	5	3	5	4	8	1	2.3	1,040	831	772
1968	1,060	6	3	5	4	9	1	1.6	835	874	606
Total	45,124	219	96	137	159	257	30	-	-	26,957	-
Mean	1,612	8	3	5	6	9	1	1.3	641	963	439

Table 23

Units: $1,000^{1/}$ Dissolved constituent loads of Colorado River at Lees Ferry, Arizona

Calendar year	Mean discharge (a.f.)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO3)	Sulfate (SO4)	Chloride (Cl)	SAR 2/	$Kx10^6$ at 25° C. 3/	T.D.S. Tons	T.D.S. mg/1
1941	17,857	91	48	60	68	115	24		*770	12,481	514
1942	14,793	62	39	46	51	84	19		*700	9,381	466
1943	11,413	52	33	49	39	74	21	1.8	808	8,375	539
1944	13,019	54	33	50	42	74	22	1.7	732	8,525	481
1945	11,769	57	33	48	44	71	22		*800	8,501	531
1946	8,751	52	29	39	39	64	20		*910	7,346	617
1947	14,046	72	38	48	55	82	20		*760	9,513	498
1948	12,885	61	32	48	48	71	21	1.5	748	8,531	487
1949	14,604	71	38	54	58	82	24	1.5	769	9,954	501
1950	10,802	55	33	45	44	70	20	1.7	844	8,098	551
1951	9,901	54	30	43	41	67	20	1.7	882	7,833	581
1952	17,903	82	43	61	70	92	24	1.4	710	11,396	468
1953	8,729	49	29	44	36	66	20	1.9	943	7,485	630
1954	6,165	42	22	39	29	57	18	2.3	1,130	6,386	761
1955	6,966	45	24	38	33	56	18	2.0	1,020	6,548	691
1956	8,658	48	24	36	37	52	18	1.6	840	6,513	553
1957	18,700	101	41	58	82	92	25	1.3	766	12,646	497
1958	13,139	71	30	47	58	70	22	1.4	782	9,280	519
1959	7,061	44	22	39	30	55	18	2.0	1,010	6,766	704
1960	8,790	51	20	38	36	54	17	1.7	851	7,092	593
1961	7,314	51	21	38	31	59	18	1.9	1,030	7,065	710
1962	14,439	76	31	52	61	76	22	1.5	763	10,319	525
1963	1,384	10	6	11	6	15	6	3.0	1,350	1,758	934
1964	3,243	23	11	21	13	31	11	2.4	1,200	3,578	811
1965	11,585	61	29	51	41	78	23	1.9	865	9,008	572
1966	7,739	37	20	32	26	49	13	1.9	802	5,439	517
1967	7,560	41	22	39	27	57	18			6,387	621
1968	8,782	49	28	47	33	70	21			7,725	647
Total	297,990	1,562	809	1,221	1,178	1,883	545	-	-	223,929	-
Mean	10,642	56	29	44	42	67	19	1.7	831	7,997	552

*Correlated

1/ Except SAR, specific conductance, and mg/1.
2/ Sodium adsorption ratio.
3/ Specific conductance.
Mg/1 of ion = 735 x Ionic load x atomic of ion ÷ discharge (a.f.).

Table 24

Units: 1,000[1/] Dissolved constituent loads of the Colorado River below Hoover, Dam, Ariz.-Nev.

Calendar year	Mean discharge (a.f.)	Ionic loads in tons equivalent: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO3)	Sulfate (SO_4)	Chloride (Cl)	SAR[2/]	Kx10[6] at 25° C. [3/]	T.D.S. Tons	T.D.S. mg/l
1941	14,889	107	44	83	50	143	43	2.1	1,110	14,897	735
1942	15,762	109	48	88	56	146	43	2.1	1,070	15,381	717
1943	12,715	80	37	67	44	108	31	2.1	1,010	11,502	665
1944	14,427	90*	44*	77*	52*	122*	39*	2.1	1,040	13,607	693
1945	12,512	76*	36*	64*	45*	98*	34*	2.1	1,020	11,512	676
1946	10,585	63*	32*	54*	38*	83*	29*	2.1	1,010	9,626	668
1947	10,959	66*	33*	59*	40*	87*	31*	2.2	1,020	10,283	690
1948	13,051	80*	38*	67*	47*	104*	34*	2.1	989	11,713	660
1949	13,566	79*	39*	69*	48*	104*	35*	2.1	947	11,250	610
1950	12,016	70*	35*	59*	43*	89*	32*	2.0	963	10,046	614
1951	9,870	56	31*	53*	37*	76*	28*	2.2	978	9,005	671
1952	15,816	86	45	79	55*	116*	40*	2.1	938	13,401	623
1953	11,302	66	31	58	41*	85*	29*	2.1	974	10,093	656
1954	10,514	65	30	58	39*	85*	29*	2.2	1,030	9,913	693
1955	8,589	61	27	56	33*	81*	31*	2.5	1,190	9,393	804
1956	7,812	54	29	54	30	76*	31*	2.6	1,230	8,918	839
1957	9,323	61*	30*	58*	35*	82*	33*	2.4	1,140	9,681	763
1958	11,877	68	31	58	41	87*	30*	2.0	948	10,243	634
1959	9,282	52	25	44	33	67*	23*	2.0	944	7,841	621
1960	8,997	55	25	48	32	70*	26*	2.2	1,000	8,209	671
1961	8,586	54*	27*	48*	31*	71*	28*	2.2	1,040	8,139	697
1962	8,615	55*	25*	48*	31*	71*	26*	2.2	1,100	8,033	685
1963	8,533	52*	24*	45*	31*	66*	25*	2.1	1,020	7,882	677
1964	8,163	51*	25*	48	28	69	29	2.4	1,070	8,014	722
1965	7,792	54	26	54	28	71	32	2.6	1,220	8,574	809
1966	7,777	49	26	52	27	69	30	2.7	1,150	7,857	743
1967	7,932	47	24	47	27	64	27	2.4	1,060	7,282	675
1968	7,839	47	26	49	28	65	28	2.5	1,100	7,457	699
Total	299,101	1,853*	893*	1,644*	1,070*	2,455*	873*	-	-	279,752	-
Mean	10,682	66*	32*	59*	38*	88*	31*	2.2	1,040	9,991	687

Table 25

Units: 1,000[1/] Dissolved consitutent loads of Colorado River at Imperial Dam, Ariz.-Calif.

Calendar year	Mean discharge (a.f.)	Ionic loads in tons equivalent: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO3)	Sulfate (SO_4)	Chloride (Cl)	SAR[2/]	Kx10[6] at 25° C. [3/]	T.D.S. Tons	T.D.S. mg/l
1941	14,024	95	42	89	48	130	49	2.4	1,140	14,980	785
1942	14,714	102	45	91	51	139	46	2.4	1,140	15,917	795
1943	11,345	73	34	64	40	98	31	2.2	1,040	10,679	692
1944	13,205	82	42	77	49	114	39	2.3	1,070	12,545	698
1945	11,390	69	38	66	41	98	36	2.3	1,070	10,841	700
1946	9,486	56	31	56	34	80	31	2.4	1,060	9,041	701
1947	10,041	62	34	60	37	86	34	2.4	1,080	9,711	711
1948	12,036	73	38	69	45	100	36	2.1	1,060	11,242	687
1949	12,567	73	38	64	46	96	35	2.1	986	11,104	649
1950	9,906	57	30	54	37	76	30	2.2	1,010	8,887	659
1951	8,053	47	26	49	31	65	27	2.5	1,060	7,764	709
1952	14,815	82	46	83	54	113	44	2.3	1,010	13,485	669
1953	10,045	57	32	57	38	79	31	2.3	1,030	9,411	689
1954	9,030	53	29	56	35	74	31	2.5	1,070	9,024	735
1955	7,709	51	29	56	29	75	32	2.7	1,230	8,797	839
1956	6,266	45	24	51	24	67	31	3.0	1,350	7,828	918
1957	7,344	53	27	56	28	73	34	2.8	1,310	8,598	860
1958	10,500	65	30	69	39	87*	37*	2.6	1,100	10,626	744
1959	7,695	47	22	49	28	63*	28*	2.6	1,100	7,843	749
1960	7,107	46	20	48	26	60*	29*	2.7	1,160	7,511	777
1961	6,293	42	19	47	23	57*	29*	2.9	1,220	7,020	820
1962	6,458	43	21	51	24	61	31	3.0	1,270	7,189	818
1963	6,522	44	19	49	24	59	29	2.9	1,220	7,016	791
1964	5,900	38	19	47	22	55	28	3.1	1,270	6,616	824
1965	5,703	40	20	50	21	59	31	3.2	1,390	7,109	916
1966	5,849	40	21	53	22	60	32	3.4	1,380	7,133	896
1967	5,615	36	19	48	22	53	28	3.3	1,310	6,430	842
1968	5,741	36	20	49	23	54	29	3.3	1,310	6,611	846
Total	255,538	1,607	815	1,658	941	2,231*	928*	-	-	260,958	-
Mean	9,120	57	29	59	34	80*	33*	2.5	1,120	9,320	751

1/ Except SAR, specific conductance, and mg/l. *Estimated or partially estimated.
2/ Sodium adsorption ratio.
3/ Specific condustance.
Mg/l of ion = 735 x Ionic load x atomic st. of ion ÷ discharge (a.f.).

Table 26
Temperature of Water
Green River near Green River, Wyoming
(Units: °F)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1941														
1942														
1943														
1944														
1945														
1946														
1947														
1948														
1949														
1950														
1951					54*	56	65*	63	56*	44*	34	33		
1952	33*	32	33	41	56*	64*	66*	66	61*	48*	35	33*	568	47
1953	34	34*	37*	47*	53	63*	71	70	63*	50	40*	33	595	50
1954	34	34*	35*	47*	54*	58	68	64*	58	46	40	33*	571	48
1955	34	34	34	41	57*	63*	67	68*	56	48	35*	34*	571	48
1956	34*	34*	37*	44	55*	62	66	63*	57	44	34*			
1957				46	54	61	68	69	56*					
1958					57	64	66	68	59	47				
1959					52	63	67	65	58	45*				
1960				50	60*		72	69*						
1961				48*		68*	73*	72*	59*	45*				
1962					53	61	67	65	57	49		32		
1963	32	33	36*	46*	58	63	68*	69	63*	53*		32		
1964	32	32		40	55	59	69	66	58	49	36*	33		
1965	32	33	33	46	53	58	65	67	55*	49	38*	32	561	47
1966	33		35*	44	57*	63	71	67	61*	45	37	33		
1967	33	33	35	44	53	58	68	68	58	46	36	32	564	47
1968	32*	34	36	43	54	59	68	61	57	50*	36	32	562	47
Total	363	333	351	627	935	1,043	1,225	1,200	992	758	401	392		
Mean	33	33	35	45	55	61	68	67	58	47	36	33	571	48

*Incomplete Record

Table 27
Temperature of Water
Green River near Greendale, Utah
(Unit: °F.)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1941														
1942														
1943														
1944														
1945														
1946														
1947														
1948														
1949														
1950														
1951														
1952														
1953														
1954														
1955														
1956														
1957														
1958														
1959	33	33	34	46	54	64	68	67		48	36	32		
1960														
1961														
1962														
1963										43*	53*	47		
1964	41	37	38*	41*	41	42	45	47	48*	54*	53*	46*	533	44
1965	41*	38	39*	40	42*	46	49*	50*	51	53*	53*	49	551	46
1966	44	41*	39	39	39	39	41*	42*	44	45	46*	46	505	42
1967	41	39	38*	39	40	41	43	45	46*	46*	48	46	512	43
1968	41	39	39	39	39	39	41*	45*	46	50	52	46*	516	43
Total	241	227	227	244	255	271	287	296	235	339	341	312		
Mean	40	38	38	41	42	45	48	49	47	48	49	45		44

*Incomplete Records.

Table 28
Temperature of Water
Green River at Green River, Utah
(Unit: °F.)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1941														
1942														
1943														
1944														
1945														
1946														
1947														
1948														
1949					60*	65*	75*	76*	69*	54*	44*	35*		
1950	33*	37*	40*	53*	58*	66	73*	74*	67*		42*	35*		
1951	34*		44*	54*	61*	67*	77*	75*	68*		40*	33*		
1952	33*	35*	39*	48*						59*	43*	33*		
1953	34*	36*		52*	59*	67*	77*	73*	68*			33*		
1954	34	39*	44*	58*	65*	68*	77	74*	70*	57*	46*	34*	666	56
1955	32*	32*	36*	50*	59*	67*	75*	77	69	57*	40*	35*		
1956	35*	35*	44*	53*	62*	68*	75*	73*	64*	58*	39	33*	639	53
1957	32*	37*	43*	52*	59	65*	73*	75*				36*		
1958			47*	55*	64*	72	79*	80*	71*					
1959			48	58*	64*	72	76*							
1960														
1961														
1962														
1963														
1964														
1965				48*			74*							
1966							78*	75*	67*	53*	42*	33*		
1967	32	33*	38*	50*	57*	62*	72	73*	63*	54*	39	32	605	50
1968	32	32	37	50*	59*	64	72*	64*	59	52	43	32	596	50
Total	331	316	460	681	727	803	1,053	889	735	444	418	404	638	
Mean	33	35	42	65	61	67	75	74	67	56	42	34		53

*Incomplete Records.

Table 29
Temperature of Water
Colorado River near Glenwood Springs, Colorado
(Unit: °F.)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1949					51	54	62	65	60	49	41	36		
1950	35	35	39	46	50*	54	63	63*	59	51	41	35	571	48
1951	33*	33	39*	47	51	53	62	62*	57*	47	34	32	550	46
1952	33	33*	34	45	50	55	62*	62*	58	48*	36	32*	548	46
1953	32	33	39*	45	49	55	64*	62*	57	48	38	32	554	46
1954	32	35*	38*	50	54*	59*	68*	65	60	49	39	32	581	48
1955	32*	32	36	45*	52	56*	66*	66*	59	50	36*	33*	563	47
1956	33*	32	37	47*	52	59*	65	62	57	47	34	32*	557	46
1957	32	33	38	45	48	52*	58	61	54*	47	35	32*	535	45
1958	32	34	37	43	49	55	61	65*	56	46	37	33*	548	46
1959	32	32*	39*	47	52	56	64	64*	56*	45	35	32	554	46
1960	32	32*	38	46	50	56	63	63*	59*	49*	37*	32*	557	46
1961		33*	39*	47	53	58*	65*	66	53*	46	36			
1962			36	44	48	53	60*	61	57*	49	40*	32*		
1963	32	33	37	45*	53*	58	67*	65*	60*	55*	44	34	583	49
1964	34	36	41	50	52	55	65	65	61	47*	36*	32	574	48
1965	32	32	36*	45*	49*	52*	58*	60*	52*	47*	40*	32*	535	45
1966	32*	33*	39*	47*	51	57*	66*	65	59*	46*	38*	34*	567	47
1967	33*	34*	37*	46	50	54	64*	62*	57*	47	36	32	552	46
1968	32	33*	38*	44	51*	54	62*	61	55*	46*	35*	32*	543	45
Total	553	598	717	874	1,015	1,105	1,265	1,265	1,146	959	748	621		
Mean	33	33	38	46	51	55	63	63	57	48	37	33	557	46

*Incomplete Record

Table 30
Temperature of Water
Colorado River Below Colorado-Utah State Line
(Units: °F)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1962						63	69	73*	67	57	45	37		
1963	34	37	44	51	60	68	73	74	67	59	46	35	648	54
1964	34	34	41	52	57	62	76	72	65	54	40	34	621	52
1965	35	37	43	51	56*	59	68	70	61	55	45	35	615	51
1966	32	34	45	54	62	67	75*	73		54	43			
1967	33	37*	47	52	58	62	72	73	62	52	41	34	623	52
1968	32	36		52				64*	63*	57*				
Total	200	215	220	312	293	381	433	499	385	388	260	175		
Mean	33	36	44	52	59	64	72	71	64	55	43	35	628	52

*Incomplete Record.

Table 31
Temperature of Water
San Juan River near Archuleta, New Mexico
(Units: °F)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1941														
1942														
1943														
1944														
1945														
1946														
1947														
1948														
1949				48	55	58	69	69	62	52	39	34		
1950	33	40	46	54	58	67	74	72*	64*	59	44	37*	648	54
1951	33	38*	47	53	58*	65	76*	75	67	54*	42*	33	641	53
1952	33*	36*	41	51*	55	61	70	75*	66*		40			
1953		38	48*	57	59*	67		76*	69*		43*			
1954	34*	39*	47*	60*	64*	69*	80*	73*	72*					
1955	32	33	41	48	54	60	67	72	63*	55	39*	33*	597	50
1956	37	38	44	50	56*	65	72	69*	62	52	35	32*	612	51
1957	32	36	42	45	51	54	61	66*	59	52	39*	34	571	48
1958	33	33	39	44	51	59	66	69	61	53*		36*		
1959		37	43	50	54	57*	67	67	60	50*	38			
1960	32*	32	37	46	52	57	70	73	68	54	42	36	599	50
1961	33	37*	45*	51	57	68	74*	74	64	53	41	34	631	52
1962	32	34	43	51	55	64	75	75	68	61	50	42	650	54
1963	35	42	43*		60	64*	64	64	62		52*	45*		
1964	39*	39	41	45	53	54	62	59	60	59	48	43		
1965			42*	45*	49*	53	61*	55*			52	47		
1966	41	40	40	44	48	55	62*	57	58	51	50	43	589	49
1967	37	39	41	46	51	55	58*	52	50	52	50	43*	574	48
1968	39	41	39	43	48	59	61	55	55	52	46	43	581	48
Total	555	672	809	931	1,088	1,211	1,289	1,347	1,190	809	790	615	613	51
Mean	35	37	43	49	54	61	68	67	63	54	44	38		

*Incomplete Record

Table 32
Temperature of Water
San Juan River near Bluff, Utah
(Unit: °F.)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1941														
1942														
1943														
1944										56	44	34*		
1945	35*	40	44*	50*	59*	68*	75*	75*	67*	54*	42*	33*	642	54
1946	34*	39	47*	59*		70	78*	76	67*	54*	42*	37*		
1947	32*	40	48	54	64	66	75*	73	68*	58	40*	35*	653	54
1948	34*	39*	43*	52*	61	67*	75*	73	67*	55*	40*			
1949	34*	36*	48*	56*	60*	65	74	73	69*	54	44	35*	648	54
1950	34*	42	51	67	68	74*	76	74*	68	61	45	41*	701	58
1951	38*	43*			62*									
1952	35*	39*	42	54	61*	65*	74*	75	67*	60*	43	35*	650	54
1953	36	39	47*	52	59*	68*	75	71	63*	54*	43*			
1954	36*	42*	44	58*	64	68	76*	72	68*	56*	44*			
1955	34*		44	50*	59	65	72	74	66	56*	41*	40*		
1956	39*	38*	45	54*	61	69*	74*	69	65	53*		34*		
1957		43	47		57*	64	76*	72	68*	56*	41*	35		
1958	35*	41*	44*	51	61	68	76	75	66	57	43*	40*	657	55
1959	36*	40*	47*	56*	60*	71*	74*	72*	63*	55*	42*			
1960	33*	37	47*	53*	61*	68*	75*	72*	69*	54*	43	34*	646	54
1961	33*	39*	47	53*	60	70	76	72*	63*					
1962														
1963														
1964														
1965	39	41	47*	58*	62*	66	75	75	66	58	50	41	678	56
1966	36	39	48	57	66*	73*	81	78*	71	56	47	37	689	57
1967	33*	40	50	56	55	70	77	75	70	57	41	32	656	55
1968	32	41	48	54*	63	70	79	72	68	57*	43	36	663	55
Total	698	798	928	1,044	1,223	1,365	1,513	1,468	1,339	1,121	818	579		55
Mean	35	40	46	55	61	68	76	73	67	56	43	36		

*Incomplete Record

Table 33
Temperature of Water
Colorado River at Lees Ferry, Arizona
(Unit: °F.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Mean
1949								76	72	58	47	37	290	
1950	36	42	49	58	62	68	77	77	70	62	48	40	689	57
1951	36	40	48	59	63	67	78	77	70	68	44	36	676	56
1952	35	39	45	54	61	67	75	78	70	63		37*	624	
1953	36	41	49	57	61	67*	80	78		61	47	36	613	
1954	37	44	48	63	68	74	80	76	71	61	48	37	707	59
1955	34	36	46	54	61	69	76	79	70	60	46	40	671	56
1956	41	40	48	57	63	70	78	74	72	60	42	36	681	57
1957	38	45	52	57	61	67	73	75	68	59	44	38	677	56
1958	36	45	49	55	63	69	76	80	71	65	49	40	698	58
1959	37	45	52	65	74	82	83	74	70*				582	
1960										59	48	38*	145	
1961	34*	42*	51*	59	66	75	80*	79	67*	56*	45*	36*	690	58
1962	34*	40*	46	57*	60*	68*	76*	77	72	61	50*	40*	681	57
1963	34*	40	48*	50*	56*	58*	63*	67*	66*	63*	60*		605	55
1965	47*	45*	46*	45*	50*	56*	60*	56	74*	70*	61*	56*	666	56
1965	52*	50*	50*	50*	51*	55*	67*	68*		67*	52*	42*	604	
1966			58*	52	53	58	64	65	65	63*	57*	50*	585	
1967	44*	42*	46	47	52	57	64*	67*	68*	66	57	48*	658	55
1968	45*	46*	48*	50*	57*	63*	66*	68*	68*	66*	59*	52*	688	57
Total	656	722	879	989	1,082	1,190	1,316	1,391	1,184	1,178	904	739	12,230	57
Mean	39	42	49	55	60	66	73	73	70	62	50	41		

*Based on Incomplete Records

Table 34
Temperature of Water
Colorado River near Grand Canyon, Arizona
(Unit: °F.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Mean
1941	41	46	51	55	63	69	76	77	68	58	41	40	685	57
1942	37	40	47	57	60	68	77	77	70				533	
1943										62	47	43	152	
1944	39	43	50	57	65	69	78	77	73	63	50	39	703	59
1945	39	44	48	56	64	66	72	76	69	62*	44*	36	676	56
1946	36	39	46	61	64	71	78	77	75	58	46	41	692	58
1947	35	43	52	58	65	68	76	77	73	62	46	39	694	58
1948	36	39	47	55	63	70	79	77	74	62	46	39	687	57
1949	36	37*	49*	59*	66*	71	79	78	74	60	50	40	699	58
1950	37	43	50	58	64	71	79	76	71	64	50	42	705	59
1951	39	42	50	59	65	71	79*	77	72	60	47*	38*	699	58
1952	37	41	46	57	65	71	78	79	71	63	50	38	696	58
1953	39	41	50	58	62	68	79	77	72	61	50	38	695	58
1954	38	45	50	62	69	72	80	77	72	62	50	40	717	60
1955	37	37	47	55	63	70	78	79	73	64	50	42	695	58
1956	44	43	50	59	67	73	78	75	75	63	45	37	709	59
1957	39	45	51	57	62	67	74	78	70	62	47	39	691	58
1958	37	45	48	56	63	70	76	79	71	63	49	39	696	58
1959	37	42	50	62	67	73	79	78	72	60	49	40	709	59
1960	36	41	50	58	65	73	80	79	75	62	50	40	709	59
1961	37	44	51	57	64	75	79	78	69	58	45	38	695	58
1962	35	40	45	56	60	69	74	77	73	62	53	43	687	57
1963	36	40	49	59	63	69	75	77	72	65	55	46	706	59
1964	44*	45	47	49	61	71	77	70	70	68	58	50	710	59
1965	50	49	50	52	54	58	69	70	68	65	60	53	698	58
1966	48	48	50	54	58	62	68	70	70	64	58	48	698	58
1967	45*	47*	50*	49*	57*	62*	69*	70*	69*	66*	59*	50*	693	58
1968	45*	48*	48*	52*	55*	63*	68*	70*	70*	66*	57*	54*	696	58
Total	1,059	1,157	1,322	1,527	1,694	1,860	2,054	2,052	1,931	1,685	1,352	1,132	18,825	58
Mean	39	43	49	56	63	69	76	76	72	62	50	42		

*Incomplete Record

Table 35
Temperature of Water
Virgin River at Littlefield, Arizona
(Unit: °F.)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Mean
1947										60*	51	46	157	
1948	46	49	52	58	63	71	72	70	68	62	52	48	711	59
1949	42	46	55	60	64	72	72	69	68	61	54	47	710	59
1950	46	51	56	61	67	69	76	72	69	65	56	53	741	62
1951	49	54	58	66	66	70	73	72	69	64	55	48	744	62
1952	48	51	52	56	63	68	73	76	70	65	55	51	727	61
1953	51	53	58	63	67	70	79	74	70	62	57	49	753	63
1954	49	54	55	63	69	70	76	76	73	63	56	49	753	63
1955	48	49	55	61	65	69	73	75	71	62	55	51	734	61
1956	52	49	58	66	68	68	71	70	70	65	56	54	747	62
1957	54	58	63	68	63	68	74	71	66	61	52	49	747	62
1958	48	52	51	54	63	69	71	74	68	66	54	51	721	60
1959	50	51	57	67	69	72	77	74	69	64	55	51	756	63
1960	48	52	58	63	67	70	72	76	77	68	58	52	761	63
1961	53	59	64	71	77	81	81	79	71	68	58	52	814	68
1962	53	52	57	65	71	78	80	78	76	70	63	54	797	66
1963	51	60	63	69	76	75	79	79	75	71	59	50	807	67
1964	54	56	61	66	70	76	81	79	75	74	57	55	804	67
1965	56	57	62	63	68	76	81	82	74	69	58	48	794	66
1966	49	52	60	64	75	77	81	81	76	68	59	50	792	66
1967	51*	56*	62*	60*	68*	74	83*	82*	76*	72	59*	46	789	66
1968	48*	57	63	64*	66	79	82*	77*	77	70*	61	50*	794	66
Total	1,046	1,118	1,220	1,328	1,425	1,522	1,607	1,586	1,508	1,450	1,240	1,104		
Mean	50	53	58	63	68	72	76	75	72	66	56	50		63

*Incomplete Record.

Table 36
Temperature of Water
Colorado River below Hoover Dam, Arizona-Nevada
(Unit: °F.)

Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Mean
1941										64	63	60	187	
1942	57	56	55	55	56	58		59	60	61	62	61	640	
1943	57	55	55	56	56	56	57	58	69	60	63	60	692	58
1944	57	55	54	54	54	57	60	61	62	63*	64*	55*	696	58
1945	56*	55*	55*	56*	56*	57*	57*	63*	65*	63*	56*	57*	696	58*
1946	56*	55*	54*	54*	55*	55*	55*	55*	56*	56*	56*	57*	664	55*
1947	56*	55*	55*	54*	54*	55*	55*	55*	67*	68*	66*	59*	699	58*
1948	57*	55*	55*	55*	55*	59*	61*	62*	63*	63*	56*	54*	695	58*
1949	54*	52*	52*	52*	52*	55*	60*	61*	63*	65*	64*	56*	686	57*
1950	52*	52*	52*	52*	53*	54*	61*	60*	55*	56*	56*	56*	659	55*
1951	57*	55*	55*	55*	55*	56*	56*	56*	56*	56*	57*	57*	671	56*
1952	55*	55*	54*	54*	54*	58*	63*	64*	65*	66*	66*	58*	712	59*
1953	55*	55*	55*	55*	56*	57*	57*	57*	57*	58*	58*	58*	678	57*
1954	56*	56*	56*	56*	56*	56*	56*	57*	57*	57*	58*	58*	679	57*
1955	57*	55*	53*	53*	53*	54*	56*	55*	56*	58*	58*	58*	666	56*
1956	56*	55*	54*	53*	53*	55*	55*	55*	56*	56*	58*	58*	664	55*
1957	56*	54*	54*	54*	55*	56*	56*	56*	58*	59*	60*	60*	678	57*
1958	58*	56*	56*	55*	56*	56*	56*	56*	56*	56*	57*	57*	675	56*
1959	57*	56*	56*	56*	56*	56*	56*	56*	56*	56*	58*	56*	675	56*
1960	57*	55*	55*	54*	54*	54*	54*	54*	54*	54*	55*	55*	655	55*
1961	55*	55*	54*	54*	54*	55*	55*	55*	55*	55*	55*	55*	657	55*
1962	55*	54*	53*	53*	53*	53*	54*	54*	54*	54*	54*	54*	645	54*
1963	54*	54*	54*	54*	54*	56*	57*	57*	57*	56*	56*	56*	665	55*
1964	55*	54*	53*	55*	53*	54*	56*	56*	56*	56*	56*	56*	660	55*
1965	54*	54*	53*	53*	55*	54*	59*	56*	57*	56*	56*	56*	663	55*
1966	56*	56*	54*	54*	54*	54*	55*	55*	55*	54*	55*	55*	657	55*
1967	56*	55*	54*	54*	55*	55*	55*	56*	56*	55*	55*	55*	661	55
1968	55*	54*	54*	54*	54*	54*	55*	55*	54*	57*	57*	57*	660	55
Total	1,506	1,478	1,464	1,464	1,471	1,499	1,477	1,544	1,565	1,638	1,635	1,594	18,335	
Mean	56	55	54	54	54	56	57	57	58	58	58	57		56

*Incomplete Record

Table 37
Temperature of Water
Colorado River below Parker Dam, Arizona-California
(Unit: °F.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Total	Mean
1954		56*	57	64	71	74	77	78	77	72	64	56	746	
1955	49	48	55	60	67	74	77*	82	78	72	64	57	783	65*
1956	54	52	56	64	69	75	77	79	78	74	62	53	793	66
1957	52	53	60	64	68	74	78	80	78	73	63	54	797	66
1958	52	57	59	64	71	73	77	79	78	74	64	57	805	67
1959	53	54	58	65	71	74	79	79	76	71	64	56	800	67
1960	51	52	57	65	66	68	68	75	74	70	64	53	763	64
1961	50	54	58	65	71	74	76	79	76	71	61	53	788	66
1962	50*	53	56	65	68	72	75	76	76	73	65	59	788	66*
1963	51*	52	58	63	67	72	75	79	80	74	66	56	793	66*
1964	50*	50	54	61	68	72	77	78	76	73	65	55	779	65*
1965	54	55	57	64	69	72	76	78	74	72	65	55	791	66
1966	51	52	56	65	70	74	76	77	74	72	63	55	785	65
1967	50*	52*	58	62	68*	72	77	78	78	72	68	57	792	66
1968	50*	55*	61	64	70	72*	75*	75*	77	72	64	54	789	66
Total	717	795	860	955	1,034	1,092	1,140	1,172	1,150	1,085	962	830	11,792	
Mean	51	53	57	64	69	73	76	78	77	72	64	55		66

*Incomplete record.

Table 38
Temperature of Water
Colorado River at Imperial Dam, Arizona-California
(Unit: °F.)

Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Mean
1956	57*	54	61	67	74	81	84	84	82	72	57	51	824	69
1957	53	59	64	67	72	81	86	85	81	71	61	54	834	70
1958	52	57	60	67	77	80	84	86	82	74	61	55	835	70
1959	52	54	60	69	74	82	85	86	80	72	62	54	830	69
1960	54	54	62	68	74	80	83	84	81	72	61	53	826	69
1961	52	56	60	68	74	81	84	86	79	70	58	53	821	68
1962	51	58	58	70	74	80	84	84	83	73*	64	57	836	70
1963	51	58	62	67	75	79	84	85	83	76	62	54	836	70
1964	48	51	58	66	72	80	84	86	80	75	63*	55	818	68
1965	54	55	60	68	74	77	85	86	80	71	64*	54*	828	69
1966	50	51	59	68	75*	78	84	85	80	71*	63*	55*	819	68
1967	52	56*	62	64	72	78	85	86	81*	75	64*	52*	827	69
1968	52	57	64	68	75	82	86	84	82	72	64*	54*	840	70
Total	678	720	790	877	962	1,039	1,098	1,107	1,054	944	804	701	10,774	
Mean	52	55	61	67	74	80	84	85	81	73	62	54		69

*Incomplete Record

Table 39

Colorado River Basin

Historical Flow and Sedimentation Data

Green River near Jensen, Utah

Flow (1,000 A.F.) · Weighted mean concentration (p.p.m.) · Load (1,000 tons)

Month	Year 1949 Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Year 1955 Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Year 1961 Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Year 1967 Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Jan.	53	100	7	37	70	4	46	60	4	163	240	53
Feb.	56	150	12	40	80	4	48	50	3	122	235	39
March	159	2,180	470	102	1,290	180	115	1,450	227	144	812	159
April	406	2,950	1,628	271	3,510	1,296	161	1,120	245	219	1300	388
May	940	2,140	2,744	562	1,350	1,035	354	1,420	685	463	1640	1030
June	1,079	2,380	3,494	540	520	379	472	1,160	744	676	940	869
July	372	980	493	178	1,170	284	94	90	12	319	570	247
Aug.	111	360	54	112	4,430	673	62	2,750	232	219	260	79
Sept.	64	130	11	50	300	21	94	2,340	299	204	380	105
Oct.	119	1,670	269	51	100	7	148	990	199	222	260	79
Nov.	106	230	33	55	260	19	103	270	38	204	120	34
Dec.	64	120	11	76	1,160	121	71	190	18	220	210	64
Total	3,529	1,920	9,226	2,074	1,430	4,023	1,768	1,120	2,706	3175	730	3146

Month	Year 1950 Flow	Conc.	Load	Year 1956 Flow	Conc.	Load	Year 1962 Flow	Conc.	Load	Year 1968 Flow	Conc.	Load
Jan.	77	160	16	80	230	25	63	40	3	218	170	51
Feb.	72	350	34	50	110	7	260	13,360	4,723	153	140	29
March	208	2,640	747	272	9,290	3,437	273	16,820	6,246	135	290	53
April	531	5,020	3,624	454	1,680	1,039	914	6,170	7,667	227	1440	445
May	843	2,460	2,822	918	1,960	2,452	1,050	1,750	2,495	617	1540	1297
June	1,202	1,500	2,447	992	1,170	1,581	820	1,270	1,418	782	850	907
July	577	880	688	252	240	81	451	780	481	344	280	129
Aug.	193	260	69	142	750	145	144	180	35	256	590	206
Sept.	106	920	132	61	90	8	58	130	10	202	90	24
Oct.	101	120	17	60	290	24	68	60	6	179	70	16
Nov.	107	180	26	62	260	22	35	20	1	182	80	19
Dec.	90	100	12	47	80	5	32	50	2	183	80	21
Total	4,107	1,900	10,634	3,390	1,910	8,826	4,168	4,070	23,088	3478	680	3197

Month	Year 1951 Flow	Conc.	Load	Year 1957 Flow	Conc.	Load	Year 1963 Flow	Conc.	Load	Year ___ Flow	Conc.	Load
Jan.	70	110	11	46	60	3	46	100	6			
Feb.	95	360	46	65	580	51	63	200	17			
March	147	2,500	500	141	1,520	292	58	1,060	84			
April	344	2,030	948	264	1,510	544	121	630	104			
May	788	1,930	2,070	854	2,150	2,502	339	1,480	682			
June	1,033	1,170	1,643	1,573	1,380	2,950	204	530	147			
July	502	480	325	906	770	955	31	50	2			
Aug.	275	1,190	446	236	770	246	28	5,170	197			
Sept.	120	250	42	122	320	54	30	2,080	85			
Oct.	138	2,470	465	122	130	22	21	140	4			
Nov.	83	300	34	102	120	16	38	830	43			
Dec.	74	60	6	75	140	13	64	460	40			
Total	3,669	1,310	6,536	4,506	1,250	7,648	1,043	990	1,411			

Month	Year 1952 Flow	Conc.	Load	Year 1958 Flow	Conc.	Load	Year 1964 Flow	Conc.	Load
Jan.	71	80	7	68	30	3	74	470	47
Feb.	74	130	13	102	520	72	76	370	38
March	91	350	44	153	940	196	63	310	27
April	773	6,780	7,142	356	1,930	935	147	3,190	638
May	1,421	2,370	4,582	1,103	1,690	2,528	538	2,470	1,811
June	1,199	1,290	2,106	805	800	881	486	810	537
July	326	670	300	142	180	35	255	500	172
Aug.	178	900	218	75	110	11	147	750	150
Sept.	93	200	26	54	200	15	142	240	46
Oct.	69	30	3	58	60	5	168	220	51
Nov.	58	60	4	60	70	6	158	210	46
Dec.	55	40	3	62	70	6	214	350	133
Total	4,408	2,410	14,448	3,038	1,140	4,693	2,468	1,100	3,696

Month	Year 1953 Flow	Conc.	Load	Year 1959 Flow	Conc.	Load	Year 1965 Flow	Conc.	Load
Jan.	73	90	9	47	60	4	259	710	250
Feb.	73	70	7	55	40	3	247	760	280
March	126	1,040	179	105	910	130	272	700	260
April	198	1,170	314	199	1,370	371	413	4,360	2,448
May	421	1,690	970	438	400	238	598	1,890	1,539
June	936	1,620	2,070	696	590	555	695	1,580	1,494
July	281	340	131	260	990	351	237	2,220	716
Aug.	143	640	125	127	1,110	192	104	1,140	162
Sept.	59	30	3	87	7,860	930	109	2,430	360
Oct.	53	30	2	123	4,210	705	150	510	104
Nov.	67	60	5	102	2,790	387	161	370	82
Dec.	56	60	5	56	110	8	159	360	77
Total	2,486	1,130	3,820	2,295	1,240	3,875	3,404	1,680	7,772

Month	Year 1954 Flow	Conc.	Load	Year 1960 Flow	Conc.	Load	Year 1966 Flow	Conc.	Load
Jan.	52	50	4	50	60	4	112	420	64
Feb.	73	180	18	52	70	5	104	440	62
March	115	530	84	272	8,050	2,978	246	4,230	1,415
April	255	1,170	407	468	2,070	1,320	322	1,430	627
May	572	1,600	1,249	492	1,330	891	418	1,080	612
June	332	1,080	488	554	1,030	778	257	580	202
July	307	840	350	129	150	26	131	210	38
Aug.	101	180	25	57	3,410	264	134	1,830	333
Sept.	72	1,200	117	38	160	8	133	370	67
Oct.	77	580	61	64	560	49	155	1,850	391
Nov.	72	100	9	77	120	13	114	280	43
Dec.	33	120	5	46	80	5	135	190	34
Total	2,061	1,000	2,817	2,299	2,030	6,341	2,261	1,260	3,888

Table 40

Colorado River Basin

Historical Flow and Sedimentation Data

Green River at Green River, Utah

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1941		
Jan.	100	420	57
Feb.	126	3,400	583
March	216	5,300	1,560
April	314	3,960	1,690
May	1,172	8,080	12,890
June	1,146	4,030	6,286
July	359	1,310	641
Aug.	267	12,130	4,416
Sept.	182	5,400	1,336
Oct.	318	6,900	2,986
Nov.	240	1,740	569
Dec.	168	430	99
Total	4,608	5,280	33,113
	Year 1942		
Jan.	112	590	91
Feb.	122	230	38
March	264	3,790	1,363
April	858	10,420	12,170
May	980	5,280	7,040
June	1,271	3,250	5,618
July	414	1,410	795
Aug.	152	560	120
Sept.	91	570	71
Oct.	118	1,280	205
Nov.	124	260	44
Dec.	116	230	36
Total	4,622	4,390	27,591
	Year 1943		
Jan.	112	150	23
Feb.	130	410	72
March	236	1,670	536
April	569	4,140	3,208
May	763	2,520	2,618
June	1,074	2,920	4,276
July	612	1,360	1,132
Aug.	300	8,070	3,298
Sept.	116	1,470	232
Oct.	124	2,600	439
Nov.	146	920	183
Dec.	112	240	37
Total	4,294	2,750	16,054
	Year 1944		
Jan.	80	300	32
Feb.	111	290	44
March	252	3,600	1,237
April	529	9,810	7,060
May	924	6,040	7,604
June	1,391	2,840	5,373
July	591	1,410	1,134
Aug.	143	390	75
Sept.	73	140	14
Oct.	115	570	89
Nov.	119	170	28
Dec.	88	90	11
Total	4,416	3,780	22,701
	Year 1945		
Jan.	109	100	15
Feb.	128	260	45
March	185	1,220	309
April	291	3,590	1,420
May	909	3,380	4,182
June	1,016	2,390	3,304
July	701	1,740	1,660
Aug.	335	4,750	2,169
Sept.	163	1,350	299
Oct.	161	800	175
Nov.	149	250	51
Dec.	113	210	32
Total	4,260	2,360	13,661
	Year 1946		
Jan.	123	180	30
Feb.	117	340	54
March	236	1,200	385
April	528	3,460	2,491
May	775	2,190	2,308
June	746	1,860	1,888
July	264	540	193
Aug.	152	6,540	1,354
Sept.	105	3,090	440
Oct.	149	3,820	774
Nov.	170	1,800	418
Dec.	154	640	135
Total	3,519	2,190	10,470

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1947		
Jan.	92	670	84
Feb.	151	1,310	268
March	411	11,040	6,181
April	422	3,060	1,760
May	1,400	4,480	8,542
June	1,348	2,870	5,269
July	656	1,560	1,389
Aug.	365	6,910	3,439
Sept.	166	880	199
Oct.	181	1,870	461
Nov.	179	540	132
Dec.	152	360	74
Total	5,523	3,700	27,798
	Year 1948		
Jan.	141	230	44
Feb.	137	640	119
March	313	4,670	1,994
April	558	5,910	4,486
May	1,061	3,760	5,433
June	952	2,250	2,912
July	268	1,060	386
Aug.	137	3,590	671
Sept.	69	160	15
Oct.	92	1,100	139
Nov.	104	140	19
Dec.	97	190	25
Total	3,929	3,040	16,243
	Year 1949		
Jan.	100	300	41
Feb.	110	270	41
March	276	3,030	1,140
April	474	3,560	2,296
May	1,221	4,130	6,861
June	1,547	4,000	8,430
July	592	3,910	3,154
Aug.	172	1,030	242
Sept.	112	1,200	182
Oct.	207	3,960	1,115
Nov.	190	430	110
Dec.	128	160	28
Total	5,129	3,390	23,640
	Year 1950		
Jan.	141	270	51
Feb.	147	260	53
March	356	2,560	1,241
April	620	5,010	4,227
May	1,026	3,320	4,632
June	1,567	2,460	5,250
July	734	2,370	2,372
Aug.	246	300	100
Sept.	149	730	148
Oct.	153	220	46
Nov.	166	150	33
Dec.	171	140	33
Total	5,476	2,440	18,186
	Year 1951		
Jan.	113	100	15
Feb.	167	230	52
March	205	770	214
April	372	2,180	1,102
May	882	2,710	3,258
June	1,309	2,330	4,155
July	627	1,430	1,222
Aug.	379	7,800	4,019
Sept.	178	1,850	447
Oct.	211	3,880	1,111
Nov.	164	540	120
Dec.	132	270	48
Total	4,739	2,450	15,763
	Year 1952		
Jan.	134	240	43
Feb.	140	260	50
March	160	430	94
April	988	8,450	11,360
May	2,087	4,280	12,160
June	1,809	1,780	4,392
July	514	960	673
Aug.	315	4,100	1,758
Sept.	184	2,230	559
Oct.	129	70	13
Nov.	122	90	15
Dec.	129	130	23
Total	6,711	3,410	31,140

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1953		
Jan.	140	100	19
Feb.	141	120	24
March	217	880	259
April	221	670	201
May	454	1,760	1,090
June	1,167	2,920	4,646
July	376	770	395
Aug.	212	3,950	1,137
Sept.	87	270	32
Oct.	86	340	40
Nov.	125	230	39
Dec.	107	260	37
Total	3,333	1,750	7,919
	Year 1954		
Jan.	107	220	32
Feb.	138	470	88
March	169	710	164
April	270	1,610	591
May	640	2,450	2,130
June	376	780	401
July	346	2,220	1,034
Aug.	120	1,940	316
Sept.	134	13,750	2,509
Oct.	139	8,960	1,690
Nov.	120	490	80
Dec.	80	280	31
Total	2,639	2,530	9,066
	Year 1955		
Jan.	80	520	57
Feb.	86	310	36
March	237	5,980	1,933
April	311	3,720	1,574
May	677	3,320	3,060
June	654	1,740	1,552
July	223	590	180
Aug.	161	5,550	1,215
Sept.	71	2,020	194
Oct.	77	220	23
Nov.	86	230	27
Dec.	127	410	71
Total	2,790	2,610	9,922
	Year 1956		
Jan.	155	610	128
Feb.	100	310	42
March	314	7,220	3,087
April	460	3,110	1,946
May	995	3,820	5,175
June	1,207	2,720	4,463
July	294	700	281
Aug.	169	2,480	570
Sept.	72	120	12
Oct.	77	670	70
Nov.	99	430	58
Dec.	79	170	18
Total	4,021	2,900	15,850
	Year 1957		
Jan.	83	130	14
Feb.	100	250	34
March	237	1,630	526
April	290	1,700	672
May	913	3,880	4,817
June	1,871	3,030	7,722
July	1,164	2,330	3,698
Aug.	386	8,300	4,364
Sept.	202	5,870	1,613
Oct.	185	1,180	297
Nov.	228	2,890	896
Dec.	149	490	100
Total	5,808	3,130	24,753
	Year 1958		
Jan.	128	240	42
Feb.	183	1,320	331
March	246	1,580	529
April	432	3,660	2,151
May	1,311	4,570	8,151
June	1,174	2,440	3,989
July	224	300	90
Aug.	110	470	70
Sept.	96	1,660	217
Oct.	91	130	16
Nov.	102	90	12
Dec.	114	160	25
Total	4,211	2,730	15,623

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1959		
Jan.	97	90	12
Feb.	114	140	21
March	146	330	66
April	219	1,120	334
May	480	1,010	661
June	763	1,390	1,446
July	346	1,300	612
Aug.	180	8,950	2,192
Sept.	104	2,200	311
Oct.	178	4,010	972
Nov.	152	690	143
Dec.	106	190	28
Total	2,885	1,730	6,798
	Year 1960		
Jan.	95	270	35
Feb.	102	170	23
March	320	6,470	2,815
April	534	2,880	2,091
May	551	1,420	1,067
June	682	1,320	1,228
July	170	250	58
Aug.	69	920	86
Sept.	59	1,810	145
Oct.	96	3,260	425
Nov.	105	240	35
Dec.	80	230	25
Total	2,863	2,060	8,033
	Year 1961		
Jan.	79	150	16
Feb.	94	150	19
March	136	600	111
April	184	1,090	274
May	342	1,370	639
June	542	1,160	856
July	112	540	83
Aug.	80	6,210	676
Sept.	175	18,500	4,403
Oct.	234	5,380	1,713
Nov.	161	840	183
Dec.	126	520	90
Total	2,265	2,940	9,063
	Year 1962		
Jan.	114	980	152
Feb.	403	7,420	4,066
March	401	10,720	5,848
April	1,093	8,470	12,587
May	1,350	3,960	7,277
June	1,074	1,920	2,801
July	598	1,230	1,003
Aug.	176	240	58
Sept.	98	12,690	1,691
Oct.	126	4,450	763
Nov.	94	180	23
Dec.	72	130	13
Total	5,599	4,760	36,282
	Year 1963		
Jan.	71	270	26
Feb.	120	1,550	253
March	99	470	63
April	154	960	200
May	399	1,710	930
June	310	720	302
July	51	130	9
Aug.	72	14,110	1,382
Sept.	95	13,630	1,761
Oct.	47	3,070	196
Nov.	74	860	87
Dec.	84	3,270	374
Total	1,576	2,600	5,583
	Year 1964		
Jan.	109	1,170	173
Feb.	114	2,650	411
March	128	1,290	225
April	190	3,910	1,010
May	634	6,370	5,491
June	725	2,190	2,160
July	344	990	464
Aug.	196	7,430	1,981
Sept.	140	1,820	346
Oct.	196	370	98
Nov.	200	280	75
Dec.	267	450	162
Total	3,243	2,860	12,596

TABLE 40

COLORADO RIVER BASIN

HISTORICAL FLOW AND SEDIMENTATION DATA

For Green River at Green River, Utah

Month	Flow (1,000 A.F.)	Weighted mean concen-tration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concen-tration (p.p.m.)	Load (1,000 tons)
		Year 1965			Year 1968	
Jan.	300	300	124	249	120	42
Feb.	303	540	222	196	600	161
March	361	2,110	1,034	241	590	195
April	518	3,300	2,327	275	1440	538
May	819	3,130	3,486	708	1600	1540
June	1,207	3,530	5,804	1248	1570	2662
July	546	3,440	2,555	426	640	372
Aug.	228	4,510	1,399	345	4670	2193
Sept.	189	2,320	596	241	160	52
Oct.	253	1,120	384	230	310	96
Nov.	239	360	117	221	70	20
Dec.	248	420	143	209	140	39
Total	5,211	2,570	18,191	4589	1270	7910
		Year 1966			Year	
Jan.	181	200	50			
Feb.	166	150	35			
March	393	5,110	2,730			
April	390	1,090	579			
May	566	1,450	1,115			
June	325	610	269			
July	146	740	148			
Aug.	146	2,200	437			
Sept.	157	2,070	442			
Oct.	193	1,260	332			
Nov.	158	1,660	357			
Dec.	148	4,090	823			
Total	2,969	1,810	7,317			
		Year 1967			Year	
Jan.	196	430	115			
Feb.	169	400	93			
March	256	1,440	503			
April	260	700	248			
May	504	2,850	1,952			
June	1,134	3,630	5,602			
July	508	2,270	1,571			
Aug.	247	1,910	641			
Sept.	231	1,790	561			
Oct.	250	450	152			
Nov.	243	120	39			
Dec.	229	120	36			
Total	4,227	2,000	11,513			

Table 41

Colorado River Basin

Historical Flow and Sedimentation Datc

Colorado River near Cisco, Utah

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
		Year 1942			Year 1948	
Jan.	181	300	74	191	360	94
Feb.	166	400	90	210	2,130	610
March	228	2,200	684	245	1,350	449
April	1,344	7,000	12,800	830	4,280	4,832
May	1,809	2,700	6,650	1,959	1,580	4,216
June	1,961	900	2,400	1,499	670	1,373
July	579	600	473	446	220	133
Aug.	185	200	50	225	2,020	619
Sept.	134	300	55	121	310	52
Oct.	162	260	57	175	310	74
Nov.	186	170	42	204	60	16
Dec.	164	100	21	186	110	28
Total	7,099	2,420	23,396	6,291	1,460	12,496
		Year 1943			Year 1949	
Jan.	153	150	31	188	160	40
Feb.	146	230	46	187	1,530	389
March	174	260	62	243	1,430	474
April	709	1,430	1,380	615	2,600	2,181
May	996	980	1,330	1,289	1,060	1,862
June	1,365	690	1,280	1,910	660	1,706
July	502	580	398	908	350	430
Aug.	368	6,170	3,090	224	2,840	866
Sept.	212	1,510	435	158	1,400	301
Oct.	184	250	62	225	1,340	412
Nov.	215	1,420	417	210	140	41
Dec.	190	170	45	180	120	30
Total	5,214	1,210	8,576	6,337	1,010	8,732
		Year 1944			Year 1950	
Jan.	140	270	52	199	280	76
Feb.	152	440	91	201	650	179
March	166	380	87	209	320	91
April	304	3,830	1,581	541	2,040	1,505
May	1,784	3,950	9,582	764	1,010	1,048
June	1,843	1,350	3,376	1,113	690	1,045
July	677	780	720	347	570	268
Aug.	149	170	35	109	150	22
Sept.	99	170	23	138	1,270	239
Oct.	159	240	53	125	130	23
Nov.	196	290	78	161	450	98
Dec.	171	100	24	167	70	16
Total	5,840	1,980	15,702	4,074	830	4,610
		Year 1945			Year 1951	
Jan.	149	100	20	153	100	21
Feb.	151	540	111	151	270	56
March	178	270	64	161	170	38
April	329	1,450	648	173	340	81
May	1,495	1,270	2,582	758	1,740	1,790
June	1,311	320	567	1,173	690	1,108
July	676	600	549	530	400	292
Aug.	446	4,560	2,773	238	4,930	1,598
Sept.	146	200	41	131	1,110	196
Oct.	217	890	262	169	810	186
Nov.	224	270	84	178	110	27
Dec.	183	240	58	172	430	101
Total	5,505	1,040	7,759	3,987	1,010	5,494
		Year 1946			Year 1952	
Jan.	174	200	46	191	470	123
Feb.	155	520	109	156	730	154
March	191	390	101	194	1,490	394
April	525	3,170	2,267	969	3,830	5,047
May	726	700	693	2,152	1,560	4,563
June	1,027	1,030	1,438	2,314	1,010	3,171
July	309	320	136	641	1,230	1,077
Aug.	196	10,200	2,717	358	1,040	506
Sept.	135	570	106	213	260	77
Oct.	206	900	253	166	50	11
Nov.	206	700	197	177	50	11
Dec.	208	300	85	188	60	14
Total	4,058	1,470	8,148	7,719	1,440	15,148
		Year 1947			Year 1953	
Jan.	145	400	79	185	50	13
Feb.	151	600	123	142	20	5
March	189	900	232	187	70	17
April	316	2,160	930	250	630	214
May	1,423	2,940	5,697	606	1,740	1,435
June	1,594	1,190	2,590	1,399	690	1,321
July	985	820	1,092	353	410	198
Aug.	369	4,520	2,274	256	5,770	2,011
Sept.	259	1,830	647	128	180	32
Oct.	328	5,230	2,338	177	5,550	1,340
Nov.	277	360	136	207	640	179
Dec.	223	440	134	171	150	34
Total	6,259	1,910	16,272	4,061	1,230	6,799

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
		Year 1954			Year 1960	
Jan.	177	170	40	164	120	26
Feb.	143	160	32	143	110	22
March	161	220	47	273	3,120	1,160
April	221	610	184	629	2,580	2,205
May	436	1,240	735	758	990	1,024
June	217	290	85	1,068	710	1,034
July	150	780	160	251	100	33
Aug.	98	2,060	276	106	120	17
Sept.	171	7,510	1,752	117	140	22
Oct.	215	3,280	962	153	270	57
Nov.	164	690	154	177	160	38
Dec.	140	240	46	165	40	9
Total	2,293	1,430	4,473	4,004	1,050	5,725
		Year 1955			Year 1961	
Jan.	134	260	47	156	30	7
Feb.	121	510	84	140	70	14
March	198	4,540	1,222	162	110	24
April	321	3,020	1,315	206	590	165
May	752	3,360	3,434	677	870	799
June	689	1,300	1,215	664	340	307
July	214	820	239	130	230	40
Aug.	185	4,710	1,187	138	1,950	366
Sept.	108	440	65	316	5,440	2,340
Oct.	119	40	7	357	2,270	1,101
Nov.	169	680	156	252	150	53
Dec.	176	130	30	197	170	45
Total	3,186	2,080	9,001	3,395	1,140	5,261
		Year 1956			Year 1962	
Jan.	155	190	40	182	520	129
Feb.	141	190	37	261	2,700	957
March	187	1,010	258	246	540	182
April	356	1,850	896	1,054	3,260	4,677
May	1,005	2,130	2,910	1,603	1,370	2,984
June	924	980	1,239	1,400	810	1,548
July	172	1,500	352	765	790	818
Aug.	119	4,370	706	206	90	25
Sept.	81	90	10	173	3,260	768
Oct.	121	380	62	262	440	156
Nov.	165	150	33	243	70	24
Dec.	142	130	26	180	100	25
Total	3,568	1,350	6,569	6,575	1,370	12,293
		Year 1957			Year 1963	
Jan.	164	640	142	163	110	25
Feb.	168	2,100	479	193	990	261
March	167	330	75	219	1,250	373
April	398	2,610	1,411	245	1,040	347
May	1,375	2,630	4,920	517	800	561
June	2,859	1,650	6,439	332	470	213
July	1,952	1,360	3,603	114	1,150	178
Aug.	661	3,990	3,588	168	6,960	1,591
Sept.	314	1,790	765	183	4,330	1,078
Oct.	292	3,170	1,257	134	450	82
Nov.	300	1,260	513	179	370	89
Dec.	239	90	29	138	260	48
Total	8,889	1,920	23,221	2,585	1,380	4,846
		Year 1958			Year 1964	
Jan.	200	130	35	132	390	70
Feb.	225	460	142	121	410	68
March	254	790	272	128	120	21
April	756	3,750	3,856	214	1,620	473
May	2,032	2,140	5,904	861	4,100	4,804
June	1,560	920	1,962	780	950	1,008
July	234	180	56	276	1,010	379
Aug.	109	850	126	241	8,710	2,855
Sept.	153	1,060	220	153	500	104
Oct.	155	120	25	164	50	11
Nov.	190	130	34	182	90	22
Dec.	176	50	13	181	550	135
Total	6,044	1,540	12,645	3,433	2,130	9,950
		Year 1959			Year 1965	
Jan.	168	70	16	162	200	44
Feb.	153	90	19	140	240	45
March	150	10	3	154	240	50
April	163	390	87	562	4,140	3,168
May	536	1,530	1,114	1,272	2,550	4,413
June	924	1,080	1,362	1,654	1,270	2,864
July	214	130	37	1,116	2,740	4,163
Aug.	160	2,790	604	447	2,810	1,707
Sept.	124	880	149	369	1,580	791
Oct.	250	1,360	464	360	2,070	1,013
Nov.	210	1,130	322	249	870	295
Dec.	163	40	9	237	430	138
Total	3,215	960	4,186	6,722	2,040	18,691

TABLE 41
COLORADO RIVER BASIN
HISTORICAL FLOW AND SEDIMENTATION DATA

For Colorado River near Cisco, Utah

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1966			Year		
Jan.	200	640	174			
Feb.	169	400	92			
March	278	2,220	838			
April	438	2,240	1,337			
May	697	1,200	1,141			
June	429	410	237			
July	185	250	63			
Aug.	120	200	32			
Sept.	145	650	129			
Oct.	175	230	55			
Nov.	153	110	23			
Dec.	174	4,400	1,041			
Total	3,163	1,200	5,162			
	Year 1967			Year		
Jan.	146	140	27			
Feb.	136	140	26			
March	185	210	53			
April	198	260	69			
May	462	2,620	1,645			
June	713	2,250	2,182			
July	327	2,580	1,147			
Aug.	175	7,520	1,791			
Sept.	178	1,620	393			
Oct.	174	180	43			
Nov.	211	200	58			
Dec.	241	590	194			
Total	3,146	1,780	7,628			
	Year 1968			Year		
Jan.	205	380	107			
Feb.	193	740	195			
March	171	270	62			
April	230	1,890	591			
May	667	3,040	2,763			
June	1,171	1,560	2,481			
July	306	1,360	565			
Aug.	365	9,140	4,537			
Sept.	159	80	18			
Oct.	213	350	101			
Nov.	257	210	73			
Dec.	248	80	28			
Total	4,185	2,020	11,521			

Table 42

Colorado River Basin

Historical Flow and Sedimentation Data

San Juan River near Bluff, Utah

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1941		
Jan.	78	15,880	1,681
Feb.	127	22,930	3,955
March	211	25,270	7,267
April	392	26,270	14,030
May	1,323	23,780	42,830
June	915	9,240	11,510
July	526	6,310	4,517
Aug.	174	24,680	5,839
Sept.	202	36,400	10,390
Oct.	655	42,080	38,890
Nov.	191	4,750	1,233
Dec.	104	2,420	344
Total	4,898	21,390	142,489
	Year 1942		
Jan.	81	2,650	293
Feb.	68	2,180	201
March	126	10,870	1,866
April	602	19,600	16,060
May	479	7,730	5,040
June	533	5,950	4,322
July	150	3,000	615
Aug.	51	1,450	100
Sept.	38	2,310	120
Oct.	37	1,680	85
Nov.	39	1,280	68
Dec.	43	2,110	124
Total	2,247	9,450	28,894
	Year 1943		
Jan.	43	3,310	195
Feb.	49	3,450	230
March	95	7,320	946
April	293	5,920	2,366
May	332	4,910	2,216
June	254	3,760	1,300
July	106	3,400	490
Aug.	91	13,320	1,652
Sept.	62	16,630	1,410
Oct.	58	3,240	257
Nov.	59	2,500	199
Dec.	51	1,740	121
Total	1,493	5,610	11,382
	Year 1944		
Jan.	37	1,420	72
Feb.	49	2,740	182
March	76	6,240	644
April	204	7,910	2,195
May	640	7,210	6,284
June	705	4,810	4,614
July	283	3,440	1,325
Aug.	61	4,840	402
Sept.	66	16,640	1,501
Oct.	75	8,220	842
Nov.	52	2,180	153
Dec.	43	1,380	80
Total	2,291	5,870	18,294
	Year 1945		
Jan.	41	1,130	63
Feb.	63	9,730	831
March	72	4,530	442
April	196	9,810	2,623
May	456	7,380	4,580
June	377	5,460	2,800
July	128	3,200	556
Aug.	96	50,850	6,879
Sept.	22	6,100	178
Oct.	62	9,800	827
Nov.	46	2,020	127
Dec.	30	3,540	145
Total	1,589	9,280	20,051
	Year 1946		
Jan.	37	2,490	125
Feb.	36	6,950	340
March	47	2,690	172
April	95	4,300	554
May	125	2,580	440
June	204	3,730	1,034
July	63	11,770	1,015
Aug.	75	32,620	3,466
Sept.	44	7,690	462
Oct.	55	4,120	309
Nov.	60	3,720	305
Dec.	46	1,420	88
Total	587	5,890	8,310

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1947		
Jan.	31	1,120	47
Feb.	45	3,700	228
March	51	2,850	200
April	68	2,860	265
May	329	6,840	3,063
June	276	3,210	1,206
July	110	1,880	280
Aug.	294	48,080	19,920
Sept.	124	14,950	2,531
Oct.	207	39,860	11,630
Nov.	77	1,540	161
Dec.	65	4,370	389
Total	1,677	17,500	39,920
	Year 1948		
Jan.	52	2,080	148
Feb.	79	9,250	992
March	90	8,570	1,044
April	358	8,030	3,919
May	519	6,630	4,685
June	603	6,900	5,665
July	147	4,380	876
Aug.	86	23,100	2,693
Sept.	36	17,810	861
Oct.	75	22,680	2,313
Nov.	55	21,380	1,600
Dec.	41	4,830	271
Total	2,141	8,610	25,067
	Year 1949		
Jan.	63	11,700	1,003
Feb.	74	19,360	1,949
March	152	11,650	2,417
April	338	14,380	6,624
May	503	5,780	3,958
June	748	8,270	8,423
July	342	7,130	3,315
Aug.	90	17,650	2,166
Sept.	41	9,370	527
Oct.	56	7,250	554
Nov.	45	1,600	97
Dec.	35	1,400	66
Total	2,487	9,190	31,099
	Year 1950		
Jan.	41	2,010	113
Feb.	49	2,780	184
March	56	2,200	168
April	130	4,150	767
May	169	2,250	520
June	191	3,350	872
July	68	7,410	690
Aug.	15	2,010	40
Sept.	42	18,050	1,026
Oct.	30	1,320	54
Nov.	25	640	21
Dec.	32	470	21
Total	854	3,850	4,475
	Year 1951		
Jan.	30	300	12
Feb.	29	650	26
March	34	560	26
April	34	640	30
May	142	3,740	720
June	188	790	203
July	30	200	8
Aug.	19	17,260	1,160
Sept.	45	30,300	1,850
Oct.	35	7,720	370
Nov.	39	7,380	390
Dec.	36	10,490	510
Total	691	5,650	5,305
	Year 1952		
Jan.	88	18,380	2,201
Feb.	40	2,720	150
March	87	17,290	2,044
April	453	12,170	7,494
May	618	5,690	4,786
June	769	4,910	5,140
July	238	5,490	1,778
Aug.	83	6,300	715
Sept.	56	31,220	2,397
Oct.	38	3,110	159
Nov.	41	3,490	193
Dec.	43	3,090	183
Total	2,554	7,350	27,240

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1953		
Jan.	42	2,070	119
Feb.	36	1,320	64
March	56	3,160	239
April	107	3,840	561
May	156	3,900	830
June	267	2,510	912
July	77	44,350	4,803
Aug.	71	43,820	4,389
Sept.	12	3,000	49
Oct.	54	22,400	1,642
Nov.	55	6,350	475
Dec.	35	1,560	73
Total	968	10,750	14,156
	Year 1954		
Jan.	32	1,400	62
Feb.	36	1,360	66
March	48	5,730	374
April	113	4,920	755
May	218	4,660	1,381
June	120	2,800	456
July	120	27,750	4,523
Aug.	66	15,690	1,407
Sept.	89	36,410	4,588
Oct.	95	19,150	2,488
Nov.	39	1,090	58
Dec.	35	1,510	71
Total	1,011	11,800	16,229
	Year 1955		
Jan.	31	1,160	48
Feb.	34	2,640	122
March	63	7,080	607
April	62	4,010	341
May	186	6,660	1,689
June	208	4,640	1,314
July	65	20,960	1,848
Aug.	143	51,750	10,410
Sept.	28	6,700	251
Oct.	25	1,730	58
Nov.	31	1,730	73
Dec.	35	1,840	89
Total	911	13,620	16,850
	Year 1956		
Jan.	41	2,270	125
Feb.	34	2,190	101
March	75	7,650	776
April	107	4,710	684
May	241	6,240	2,048
June	203	3,700	1,025
July	31	13,400	572
Aug.	36	60,400	3,033
Sept.	4	1,480	8
Oct.	13	4,970	86
Nov.	30	3,940	158
Dec.	25	2,210	76
Total	840	7,630	8,692
	Year 1957		
Jan.	38	5,570	285
Feb.	64	14,190	1,241
March	71	6,200	596
April	171	9,780	2,278
May	327	7,670	3,415
June	786	5,490	5,879
July	566	7,600	5,861
Aug.	364	24,270	12,010
Sept.	142	15,140	2,933
Oct.	150	21,950	4,478
Nov.	141	7,560	1,449
Dec.	88	2,000	239
Total	2,908	10,400	41,164
	Year 1958		
Jan.	53	14,010	101
Feb.	119	14,790	2,392
March	159	12,380	2,678
April	413	11,620	6,526
May	742	5,220	5,272
June	507	3,150	2,174
July	74	2,590	261
Aug.	42	22,150	1,265
Sept.	61	17,260	1,432
Oct.	47	5,040	322
Nov.	43	1,540	90
Dec.	36	780	38
Total	2,296	7,220	22,551

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
	Year 1959		
Jan.	30	510	21
Feb.	31	1,260	53
March	32	760	33
April	39	5,410	287
May	110	3,190	478
June	156	1,950	413
July	18	740	18
Aug.	64	37,070	3,227
Sept.	11	4,080	61
Oct.	92	18,850	2,358
Nov.	82	7,840	874
Dec.	46	2,110	132
Total	711	8,230	7,955
	Year 1960		
Jan.	37	2,190	110
Feb.	43	3,470	203
March	260	24,170	8,546
April	336	5,000	2,284
May	285	3,340	1,294
June	382	2,850	1,481
July	92	1,110	139
Aug.	18	2,040	50
Sept.	17	950	22
Oct.	58	15,820	1,248
Nov.	40	1,250	68
Dec.	40	2,540	138
Total	1,608	7,130	15,583
	Year 1961		
Jan.	35	880	42
Feb.	41	3,070	171
March	66	3,960	355
April	157	3,970	848
May	285	2,580	999
June	227	1,590	492
July	43	4,260	249
Aug.	87	30,020	3,552
Sept.	109	21,750	3,224
Oct.	98	8,490	1,132
Nov.	72	3,810	373
Dec.	44	400	24
Total	1,264	6,670	11,461
	Year 1962		
Jan.	36	370	18
Feb.	94	14,140	1,808
March	73	3,610	358
April	315	4,530	1,939
May	346	2,140	1,007
June	296	1,740	702
July	87	720	85
Aug.	23	160	5
Sept.	26	39,540	1,398
Oct.	104	38,980	5,513
Nov.	45	1,930	118
Dec.	33	220	10
Total	1,478	6,440	12,961
	Year 1963		
Jan.	25	410	14
Feb.	39	1,550	82
March	40	1,010	55
April	64	2,530	220
May	95	5,070	655
June	47	670	43
July	15	2,740	56
Aug.	48	35,630	2,326
Sept.	70	39,760	3,785
Oct.	41	19,260	1,074
Nov.	47	4,470	286
Dec.	48	3,970	259
Total	579	11,250	8,855
	Year 1964		
Jan.	44	2,470	148
Feb.	30	2,160	88
March	28	1,680	64
April	30	2,210	90
May	103	8,920	1,250
June	121	6,500	1,070
July	114	10,670	1,654
Aug.	131	44,920	8,003
Sept.	56	24,280	1,849
Oct.	37	1,890	95
Nov.	42	2,490	142
Dec.	60	3,730	304
Total	796	13,630	14,759

TABLE 42
COLORADO RIVER BASIN
HISTORICAL FLOW AND SEDIMENTATION DATA

For San Juan River near Bluff, Utah

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
		Year 1965			Year 1968	
Jan.	122	9,510	1,578	36	2,370	113
Feb.	120	6,470	1,056	54	5,040	370
March	85	6,660	770	50	3,910	266
April	165	17,560	3,943	83	6,750	762
May	288	22,740	8,910	148	6,550	1,319
June	419	6,050	3,448	240	7,730	2,533
July	295	5,870	2,355	82	15,130	1,687
Aug.	218	35,900	10,650	176	53,150	12,722
Sept.	177	6,570	1,583	41	6,060	338
Oct.	190	5,140	1,328	56	3,390	258
Nov.	232	5,420	1,712	49	1,800	120
Dec.	235	6,610	2,115	45	770	47
Total	2,546	11,480	39,448	1,060	14,240	20,535
		Year 1966			Year	
Jan.	198	3,230	869			
Feb.	129	2,070	363			
March	199	6,940	1,878			
April	252	3,020	1,036			
May	267	2,460	894			
June	127	1,810	312			
July	54	6,530	480			
Aug.	44	23,770	1,423			
Sept.	43	12,320	721			
Oct.	95	4,030	521			
Nov.	70	2,030	193			
Dec.	72	7,690	753			
Total	1,550	4,480	9,443			
		Year 1967			Year	
Jan.	58	810	64			
Feb.	64	2,040	178			
March	79	1,540	166			
April	31	400	17			
May	78	4,120	437			
June	89	8,070	977			
July	39	15,330	813			
Aug.	151	47,130	9,679			
Sept.	94	25,880	3,308			
Oct.	31	7,800	329			
Nov.	38	9,150	473			
Dec.	39	3,040	161			
Total	791	15,430	16,602			

Table 43

Colorado River Basin

Historical Flow and Sedimentation Data

Colorado River at Lees Ferry, Arizona

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Year 1943			
Jan.	330	1,830	822
Feb.	332	2,920	1,321
March	516	6,540	4,595
April	1,450	5,690	11,220
May	2,158	3,770	11,070
June	2,729	4,610	17,130
July	1,429	1,860	3,624
Aug.	793	7,360	7,943
Sept.	448	3,870	2,358
Oct.	378	4,230	2,172
Nov.	456	2,660	1,651
Dec.	395	1,730	928
Total	11,414	4,180	64,834
Year 1944			
Jan.	278	1,230	465
Feb.	344	1,530	717
March	509	3,910	2,709
April	1,027	8,280	11,570
May	3,251	6,820	30,160
June	4,136	3,600	20,260
July	1,782	2,350	5,695
Aug.	417	1,320	748
Sept.	229	640	200
Oct.	342		*3,300
Nov.	384		*750
Dec.	320		*450
Total	13,019	4,350	77,024
Year 1948			
Jan.	406	2,040	1,127
Feb.	458	4,250	2,649
March	645	5,550	4,877
April	1,703	9,280	21,510
May	3,507	5,600	26,740
June	3,339	3,920	17,820
July	980	1,830	2,439
Aug.	531	9,190	6,644
Sept.	230	2,580	807
Oct.	331	4,010	1,804
Nov.	408	6,100	3,386
Dec.	347	1,850	875
Total	12,885	5,170	90,678
Year 1949			
Jan.	337	3,500	1,607
Feb.	361	4,580	2,251
March	706	5,920	5,689
April	1,307	6,660	11,860
May	3,098	5,240	22,110
June	4,419	5,220	31,390
July	2,137	3,930	11,440
Aug.	576	4,320	3,386
Sept.	313	2,290	975
Oct.	509	5,390	3,736
Nov.	473	1,730	1,114
Dec.	368	1,190	598
Total	14,604	4,790	95,156
Year 1950			
Jan.	350	1,630	776
Feb.	398	1,660	900
March	650	2,990	2,649
April	1,217	5,180	8,585
May	1,971	3,960	10,610
June	2,979	3,170	12,840
July	1,377	4,630	8,680
Aug.	422	1,290	743
Sept.	330	5,060	2,275
Oct.	342	1,320	615
Nov.	350	1,090	520
Dec.	415	1,190	670
Total	10,801	3,390	49,863
Year 1951			
Jan.	315	900	384
Feb.	361	1,240	608
March	417	1,070	609
April	531	2,120	1,536
May	1,645	3,920	8,782
June	2,886	3,390	13,300
July	1,357	1,640	3,021
Aug.	787	12,720	13,630
Sept.	411	7,580	4,235
Oct.	412	5,460	3,064
Nov.	445	4,000	2,423
Dec.	333	1,530	696
Total	9,900	3,880	52,288
Year 1952			
Jan.	476	5,500	3,561
Feb.	379	1,740	896
March	440	2,850	1,708
April	2,267	9,610	29,650
May	5,081	5,120	35,390
June	5,192	3,330	23,550
July	1,573	2,000	4,293
Aug.	821	4,300	4,812
Sept.	542	6,510	4,805
Oct.	369	1,030	519
Nov.	386	1,200	632
Dec.	378	1,240	640
Total	17,904	4,540	110,456
Year 1953			
Jan.	394	1,220	656
Feb.	365	1,140	569
March	458	1,460	908
April	529	1,530	1,101
May	1,047	3,370	4,810
June	2,992	3,540	14,430
July	950	3,090	3,993
Aug.	661	13,020	11,720
Sept.	258	4,110	1,442
Oct.	321	6,010	2,622
Nov.	414	3,240	1,823
Dec.	341	1,650	768
Total	8,730	3,780	44,842
Year 1954			
Jan.	318	1,730	748
Feb.	342	1,770	825
March	393	2,090	1,118
April	546	2,700	2,008
May	1,277	4,340	7,550
June	792	2,360	2,547
July	647	6,360	5,603
Aug.	321	4,000	1,749
Sept.	389	13,530	7,163
Oct.	512	13,540	9,443
Nov.	349	2,100	997
Dec.	278	1,210	459
Total	6,164	4,800	40,210
Year 1955			
Jan.	244	1,110	369
Feb.	243	1,120	370
March	580	8,010	6,321
April	617	4,830	4,060
May	1,570	6,090	13,020
June	1,586	3,750	8,107
July	571	2,660	2,065
Aug.	510	16,030	11,120
Sept.	230	5,450	1,705
Oct.	214	1,130	330
Nov.	275	1,530	573
Dec.	326	1,700	756
Total	6,966	5,150	48,796
Year 1956			
Jan.	373	1,930	980
Feb.	280	1,380	525
March	511	5,100	3,543
April	898	5,780	7,068
May	2,190	5,160	15,370
June	2,594	4,650	16,410
July	557	1,960	1,484
Aug.	356	7,780	3,768
Sept.	166	620	140
Oct.	187	610	154
Nov.	300	2,110	863
Dec.	247	830	280
Total	8,659	4,300	50,585
Year 1957			
Jan.	284	1,450	562
Feb.	323	3,080	1,358
March	499	2,860	1,944
April	828	4,560	5,136
May	2,569	6,140	21,460
June	5,645	4,470	34,350
July	4,015	3,910	21,330
Aug.	1,604	9,080	19,800
Sept.	822	11,630	13,000
Oct.	748	13,030	13,254
Nov.	848	8,490	9,791
Dec.	517	1,870	1,316
Total	18,702	5,630	143,301
Year 1958			
Jan.	397	1,340	721
Feb.	536	3,930	2,[illegible]
March	696	4,200	3,972
April	1,574	7,870	16,[illegible]
May	3,992	6,620	35,934
June	3,678	4,620	23,[illegible]
July	628	1,000	854
Aug.	286	3,310	1,287
Sept.	320	5,590	2,428
Oct.	311	1,280	543
Nov.	357	1,810	879
Dec.	366	1,570	780
Total	13,141	5,050	90,204
Year 1959			
Jan.	315	1,490	638
Feb.	315	1,140	488
March	344	920	430
April	420	980	558
May	1,025	1,300	1,813
June	1,836	1,020	2,559
July	782	620	661
Aug.	425	9,050	5,231
Sept.	246	3,860	1,291
Oct.	502	4,620	3,151
Nov.	499	3,150	2,141
Dec.	352	580	280
Total	7,061	2,000	19,241
Year 1960			
Jan.	305	630	263
Feb.	318	680	293
March	745	7,750	7,856
April	1,610	3,180	6,953
May	1,564	1,320	2,815
June	2,239	960	2,924
July	647	720	638
Aug.	208	940	267
Sept.	193	1,490	392
Oct.	341	7,140	3,314
Nov.	345	2,440	1,144
Dec.	275	780	292
Total	8,790	2,270	27,151
Year 1961			
Jan.	266	590	212
Feb.	331	1,880	848
March	362	1,600	786
April	567	2,900	2,235
May	1,153	2,240	3,513
June	1,588	1,180	2,545
July	369	1,170	587
Aug.	337	14,710	6,741
Sept.	711	17,860	17,274
Oct.	725	5,910	5,827
Nov.	527	2,750	1,968
Dec.	380	1,510	778
Total	7,316	4,350	43,314
Year 1962			
Jan.	349	1,490	708
Feb.	791	9,060	9,749
March	598	4,030	3,275
April	2,391	6,630	21,547
May	3,633	1,850	9,130
June	2,876	920	3,610
July	1,717	1,160	2,719
Aug.	469	1,050	664
Sept.	315	6,000	2,570
Oct.	539	14,360	10,527
Nov.	428	3,100	1,806
Dec.	333	2,100	951
Total	14,439	3,400	67,256
Year 1963			
Jan.	169	1,860	427
Feb.	369	2,550	1,278
March	188	1,080	276
April	60	40	3
May	62	40	3
June	140	420	81
July	90	330	40
Aug.	62	110	9
Sept.	60	110	9
Oct.	61	100	8
Nov.	60	120	10
Dec.	63	130	11
Total	1,384	1,140	2,155
Year 1964			
Jan.	71	560	54
Feb.	231	1,100	345
March	388	2,410	1,273
April	771	2,000	2,093
May	319	1,420	616
June	60	20	2
July	60	20	2
Aug.	174	50	12
Sept.	156	10	3
Oct.	268	30	10
Nov.	348	70	31
Dec.	398	80	41
Total	3,244	1,020	4,482
Year 1965			
Jan.	558	310	233
Feb.	515	410	288
March	556	590	448
April	1,222	1,240	2,056
May	2,284	480	1,503
June	2,323	420	1,335
July	727	10	11
Aug.	871	10	12
Sept.	750	10	10
Oct.	659		*10
Nov.	589		*10
Dec.	531		*10
Total	11,585	376	5,926
Year			
Year			
Year			
Year			

*Estimated

Table 44

Colorado River Basin

Historical Flow and Sedimentation Data

Colorado River near Grand Canyon, Arizona

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Year 1941			
Jan.	434	9,320	5,499
Feb.	515	12,640	8,851
March	838	18,520	21,110
April	1,209	13,930	22,910
May	4,976	14,000	94,760
June	4,100	7,360	41,020
July	1,753	3,280	7,814
Aug.	861	16,060	18,810
Sept.	659	16,080	14,410
Oct.	1,904	30,650	79,380
Nov.	953	3,320	4,310
Dec.	594	850	688
Total	18,796	12,500	319,562
Year 1942			
Jan.	430	620	364
Feb.	435	750	442
March	653	4,300	3,822
April	2,763	17,820	66,950
May	3,163	8,430	36,280
June	4,241	5,790	33,400
July	1,345	1,520	2,775
Aug.	486	1,340	887
Sept.	294	740	296
Oct.	356	1,370	665
Nov.	386	690	360
Dec.	373	560	285
Total	14,925	7,220	146,526
Year 1943			
Jan.	347	430	202
Feb.	351	640	305
March	580	8,060	6,360
April	1,417	9,140	17,610
May	2,161	8,420	24,750
June	2,676	6,040	22,000
July	1,459	2,630	5,220
Aug.	834	7,930	9,000
Sept.	494	5,460	3,670
Oct.	408	5,410	3,001
Nov.	477	1,850	1,199
Dec.	420	980	560
Total	11,624	5,940	93,877
Year 1944			
Jan.	298	380	156
Feb.	363	670	330
March	551	4,400	3,299
April	1,099	9,660	14,440
May	3,206	9,210	40,160
June	4,144	5,120	28,870
July	1,854	1,990	5,019
Aug.	456	1,000	621
Sept.	251	390	133
Oct.	362	4,430	2,183
Nov.	401	660	359
Dec.	345	280	133
Total	13,330	5,280	95,703
Year 1945			
Jan.	356	420	205
Feb.	381	1,970	1,021
March	472	1,730	1,111
April	804	3,700	4,046
May	2,803	7,890	30,090
June	2,754	3,760	14,100
July	1,732	2,360	5,549
Aug.	1,071	15,550	22,650
Sept.	394	4,080	2,184
Oct.	524	7,700	5,487
Nov.	465	950	600
Dec.	359	900	441
Total	12,115	5,310	87,484
Year 1946			
Jan.	384	500	262
Feb.	333	370	166
March	514	1,800	1,257
April	1,016	6,400	8,839
May	1,775	4,670	11,280
June	1,995	4,240	11,500
July	784	3,640	3,878
Aug.	567	21,400	16,500
Sept.	372	11,390	5,760
Oct.	419	3,910	2,227
Nov.	492	2,000	1,340
Dec.	468	1,430	909
Total	9,119	5,150	63,918

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Year 1947			
Jan.	303	550	228
Feb.	371	1,120	563
March	653	8,430	7,489
April	785	5,530	5,907
May	3,088	8,360	35,119
June	3,233	4,350	19,130
July	1,953	2,050	5,440
Aug.	1,329	27,860	50,360
Sept.	640	8,430	7,336
Oct.	894	24,750	30,100
Nov.	608	1,520	1,261
Dec.	490	1,610	1,070
Total	14,347	8,410	164,003
Year 1948			
Jan.	427	590	341
Feb.	458	3,090	1,923
March	669	5,730	5,217
April	1,732	12,740	30,010
May	3,392	8,930	41,200
June	3,358	4,710	21,490
July	1,009	1,450	1,995
Aug.	587	11,300	9,022
Sept.	242	1,330	437
Oct.	336	2,940	1,344
Nov.	434	2,200	1,310
Dec.	365	790	394
Total	13,009	6,480	114,683
Year 1949			
Jan.	363	2,840	1,401
Feb.	374	2,960	1,508
March	796	8,050	8,713
April	1,337	8,380	15,230
May	2,959	7,000	28,180
June	4,303	6,770	39,620
July	2,128	3,810	11,020
Aug.	632	9,850	8,466
Sept.	340	3,640	1,682
Oct.	521	5,530	3,919
Nov.	488	980	649
Dec.	381	330	173
Total	14,622	6,060	120,561
Year 1950			
Jan.	358	380	186
Feb.	414	1,020	572
March	670	2,440	2,220
April	1,192	5,730	9,289
May	1,941	5,140	13,560
June	2,925	4,630	18,420
July	1,401	4,390	8,358
Aug.	444	920	555
Sept.	343	4,030	1,880
Oct.	359	1,020	499
Nov.	355	300	147
Dec.	434	410	240
Total	10,836	3,790	55,926
Year 1951			
Jan.	326	210	91
Feb.	366	410	202
March	429	390	228
April	535	1,370	996
May	1,552	4,340	9,156
June	2,800	3,980	15,140
July	1,397	1,550	2,937
Aug.	833	11,550	13,080
Sept.	452	9,780	6,013
Oct.	425	6,150	3,554
Nov.	466	4,060	2,570
Dec.	353	950	458
Total	9,934	4,030	54,425
Year 1952			
Jan.	593	12,090	9,752
Feb.	396	970	524
March	435	1,820	1,076
April	2,209	12,020	36,117
May	5,062	7,180	49,452
June	5,203	4,100	29,019
July	1,590	1,690	3,646
Aug.	833	4,180	4,737
Sept.	596	9,350	7,581
Oct.	393	810	434
Nov.	396	410	220
Dec.	400	550	301
Total	18,106	5,800	142,859

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Year 1953			
Jan.	408	340	190
Feb.	378	330	168
March	478	900	586
April	533	860	624
May	989	3,640	4,894
June	2,932	5,080	20,243
July	980	4,290	5,723
Aug.	703	13,910	13,296
Sept.	290	5,410	2,134
Oct.	325	4,140	1,831
Nov.	428	2,140	1,246
Dec.	360	520	257
Total	8,804	4,280	51,192
Year 1954			
Jan.	333	440	198
Feb.	353	660	317
March	424	2,750	1,587
April	566	3,220	2,478
May	1,211	5,620	9,253
June	798	2,110	2,294
July	669	8,910	8,107
Aug.	349	18,580	8,820
Sept.	415	18,220	10,285
Oct.	526	14,450	10,341
Nov.	360	1,300	637
Dec.	296	700	282
Total	6,300	6,370	54,599
Year 1955			
Jan.	261	460	162
Feb.	269	470	171
March	586	8,280	6,596
April	621	4,800	4,052
May	1,515	7,680	15,818
June	1,596	6,350	13,777
July	618	3,870	3,254
Aug.	668	28,410	25,809
Sept.	265	6,200	2,233
Oct.	236	590	191
Nov.	298	1,050	424
Dec.	354	1,630	785
Total	7,287	7,390	73,272
Year 1956			
Jan.	398	1,940	1,049
Feb.	310	1,050	442
March	511	5,430	3,774
April	878	7,250	8,660
May	2,125	8,410	24,290
June	2,584	8,530	30,000
July	598	1,840	1,500
Aug.	383	9,410	4,900
Sept.	185	460	115
Oct.	202	150	41
Nov.	325	1,180	520
Dec.	274	380	141
Total	8,773	6,320	75,432
Year 1957			
Jan.	343	4,720	2,203
Feb.	370	2,830	1,422
March	541	2,280	1,679
April	812	3,990	4,411
May	2,501	8,500	28,930
June	5,541	6,790	51,141
July	4,033	4,540	24,884
Aug.	1,672	11,190	25,457
Sept.	884	12,150	14,609
Oct.	784	12,930	13,784
Nov.	892	11,220	13,617
Dec.	537	900	655
Total	18,910	7,110	182,792
Year 1958			
Jan.	415	430	244
Feb.	536	2,910	2,120
March	749	4,960	5,048
April	1,580	10,410	22,376
May	3,900	7,840	41,559
June	3,763	4,950	25,321
July	683	510	471
Aug.	337	7,200	3,300
Sept.	379	7,760	4,000
Oct.	346	1,910	900
Nov.	385	1,240	650
Dec.	388	570	300
Total	13,461	5,810	106,289

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
Year 1959			
Jan.	334	590	270
Feb.	326	680	300
March	365	1,610	800
April	423	410	237
May	1,011	2,030	2,786
June	1,804	2,080	5,096
July	795	620	672
Aug.	488	16,310	10,825
Sept.	271	4,480	1,651
Oct.	528	5,900	4,239
Nov.	569	5,990	4,633
Dec.	394	980	526
Total	7,308	3,220	32,035
Year 1960			
Jan.	348	1,510	713
Feb.	353	830	398
March	820	10,220	11,396
April	1,650	3,770	8,452
May	1,580	1,360	2,931
June	2,212	1,810	5,435
July	678	590	548
Aug.	233	220	69
Sept.	218	820	243
Oct.	382	8,920	4,637
Nov.	380	850	440
Dec.	300	140	57
Total	9,154	2,840	35,319
Year 1961			
Jan.	291	30	11
Feb.	353	340	165
March	379	970	498
April	587	2,120	1,693
May	1,147	3,560	5,557
June	1,692	2,190	5,044
July	417	1,010	575
Aug.	374	15,150	7,708
Sept.	748	20,100	20,445
Oct.	772	5,760	6,047
Nov.	570	2,750	2,132
Dec.	409	590	327
Total	7,739	4,770	50,202
Year 1962			
Jan.	369	350	174
Feb.	832	11,130	12,604
March	610	1,770	1,467
April	2,467	10,610	35,599
May	3,716	2,940	14,851
June	2,850	1,470	5,704
July	1,821	1,180	2,929
Aug.	512	1,050	730
Sept.	318	7,030	3,039
Oct.	557	11,470	8,691
Nov.	443	1,750	1,054
Dec.	344	1,000	467
Total	14,839	4,330	87,309
Year 1963			
Jan.	182	1,030	254
Feb.	374	640	324
March	203	470	130
April	72	240	24
May	79	160	17
June	148	80	17
July	108	70	10
Aug.	112	18,990	2,892
Sept.	122	37,810	6,273
Oct.	77	1,770	185
Nov.	76	570	59
Dec.	77	120	13
Total	1,630	4,600	10,198
Year 1964			
Jan.	79	110	12
Feb.	245	860	288
March	382	4,520	2,350
April	796	4,690	5,082
May	356	2,990	1,447
June	77	50	5
July	84	4,620	528
Aug.	287	23,480	9,164
Sept.	191	4,860	1,262
Oct.	298	910	368
Nov.	371	860	432
Dec.	416	1,280	724
Total	3,582	4,450	21,662

TABLE 44

COLORADO RIVER BASIN

HISTORICAL FLOW AND SEDIMENTATION DATA

For Colorado River near Grand Canyon, Arizona

Month	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)	Flow (1,000 A.F.)	Weighted mean concentration (p.p.m.)	Load (1,000 tons)
		Year 1965			Year 1968	
Jan.	608	3,270	2,704	658	650	578
Feb.	539	1,960	1,436	534	1,930	1,402
March	568	3,410	2,638	900	1,410	1,721
April	1,251	6,380	10,864	1,078	1,340	1,960
May	2,282	3,180	9,860	976	480	636
June	2,282	1,310	4,074	925	300	380
July	724	2,290	2,256	865	1,430	1,678
Aug.	879	1,790	2,138	775	5,980	6,298
Sept.	767	1,990	2,080	675	460	420
Oct.	675	160	144	647	1,030	909
Nov.	612	470	393	675	340	312
Dec.	586	1,370	1,091	665	210	188
Total	11,773	2,480	39,678	9,373	1,290	16,482
		Year 1966			Year	
Jan.	529	1,750	1,260			
Feb.	524	340	240			
March	718	1,520	1,488			
April	865	460	547			
May	1,011	400	557			
June	789	200	212			
July	698	180	168			
Aug.	694	230	218			
Sept.	623	910	770			
Oct.	567	870	668			
Nov.	589	30	23			
Dec.	670	2,480	2,263			
Total	8,277	750	8,414			
		Year 1967			Year	
Jan.	648	200	175			
Feb.	564	120	92			
March	704	150	147			
April	801	300	324			
May	861	200	229			
June	711	310	296			
July	693	4,800	4,519			
Aug.	786	8,310	8,882			
Sept.	713	6,500	6,304			
Oct.	459	870	545			
Nov.	495	300	200			
Dec.	597	570	463			
Total	8,032	2,030	22,176			